FARR

TECHNICAL MANUAL

KT5500

5-1/2” (13.97cm) 18.7K Lbs.-Ft.

Hydraulic Power Tong & CLINCHER® Backup

- *Specifications*
- *Operation*
- *Maintenance*
- *Assembly*

Model 80-0421-3

Model 80-0422

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MOVING GLOBAL ENERGY FORWARD

This manual covers the following models:

OVERALL MODEL	TONG MODEL	BACKUP MODEL	REV	DESCRIPTION
80-0420-16	80-0420-3	85-0408	0	5-1/2" configured power tong & low-profile compression load cell-style CLINCHER® backup. Tong equipped with hydraulic motor control, lift control, backup control, rigid sling, & and safety door system.
80-0421-3	80-0420-3	85-0506	0	5-1/2" configured power tong & tension load cell-style CLINCHER® backup. Tong equipped with hydraulic motor control, lift control, backup control, rigid sling, & and safety door system.
80-0422	80-0420-3	85-0404	0	5-1/2" configured power tong & compression load cell-style CLINCHER® backup. Tong equipped with hydraulic motor control, lift control, backup control, rigid sling, & and safety door system.

NOTE: ***Some illustrations used in this manual may not exactly match your model of tong.***

PATENTED & PATENTS PENDING

ORIGINAL INSTRUCTIONS

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WARNINGS

A "LOAD-BEARING DEVICE" IS A CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT FOR WHICH THIS MANUAL HAS BEEN PRODUCED

THE LOAD-BEARING DEVICE SUPPLIED BY MCCOY DRILLING & COMPLETIONS IS DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES. MCCOY DRILLING & COMPLETIONS WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO LIFT OR SUPPORT THE EQUIPMENT DESCRIBED IN THIS MANUAL IF THERE ARE ANY MODIFICATIONS TO THE LOAD-BEARING DEVICE, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

WHEN RE-ASSEMBLING LOAD-BEARING DEVICES (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS, ETC.) NOTE THAT THE ASSOCIATED FASTENERS MUST BE TIGHTENED TO THE CORRECT TORQUE SPECIFIED FOR THAT SIZE OF FASTENER (SEE SECTION 3 - OVERHAUL). ANY THREADED FASTENER IN A LOAD-BEARING DEVICE MUST BE SECURED WITH RED OR BLUE LOCTITE™.

ANY REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

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McCoy has made every effort to ensure the information contained in this document is accurate and current. This manual is intended to provide equipment operation and safety instructions for your equipment. However, McCoy does not warrant or guarantee that the information is either complete or accurate in every respect and the user of the manual should consult with its McCoy sales representative for any clarifications and updates.

The user of the manual shall protect, indemnify, and hold harmless McCoy and its directors, officers, employees, and agents from and against all liability for personal injury, death, or property damage resulting directly or indirectly from the use of the information contained in this manual.

Observance of all descriptions, information and instructions set out in this manual is the full responsibility of the user. This manual is intended for guidance and informational purposes and must be used in association with adequate training and on-the-job supervision to provide safe and effective equipment use.

It is the responsibility of the user to conform to all regulations and requirements issued by an authority or agency which may affect the operation, safety or equipment integrity, that may overrule the content of this documentation.

The user will acknowledge and obey any general legal or other mandatory regulation in force relating to accident prevention, safety, and equipment integrity.

Summary Of Revisions				
Date	**Section**	**Page**	**Description Of Revision**	**Approved**
Sep 2007	N/A	N/A	Initial Release	K.Isaacson
APR 2008	Intro	iii	Corrected table of assemblies covered by this manual, added compression LC style backup	D.Yakimchuk
	1	1.3	Added arm length specs for compression LC style backup	
	3	3.4	Added imagery for parts identification for compression LC style backup	
	7	7.38	Created parts lists for compression-style LC backup	
	8	8.1	Added compression load cell information	
	8	8.4	Added detailed compression load cell parts list	
APR 2009	7	7.21	Corrected reference to page number showing the jaw availability.	D.Bowles
AUG 2009	Intro	iii	Added model 80-0420-16 (tong with low-profile **CLINCHER®** backup)	D.Bowles
Sep 2010	N/A	N/A	Updated graphical layout to current branding standards, added 85-0404-1 to covered assemblies, added drawings for 85-0408 backup and mounting kit	K.Duhon
Nov 2011	2	2.8	Removed hydraulic schematic for assembly not equipped with safety door.	S.Hargreaves
		2.8	Corrected hydraulic schematic B.O.M.	
		2.16	Revised Section 2.F.1, Tong Rig-Up & Leveling (Suspension & Restraint)	
		2.18	Added Section 2.F.3, Tong Rig-Up & Leveling (Load Cell Configuration)	
		2.19	Inserted Section 2.G.1, Operator Training	
	3	3.1	Revised Section 3.A, General Maintenance Safety Practices	
		3.1	Revised Section 3.B, Cleaning	
		3.1	Inserted Section 3.C, Preventive Maintenance Practices	
		3.6	Added lubrication instruction, CLINCHER® cylinders	
		3.7	Added lubrication instruction, compression load cell	
		3.11-3.20	Revised Section H, Mechanical Assembly Procedures	
		3.21-3.32	Moved all maintenance procedures from appendices to maintenance section.	
	4	4.1-4.6	Revised troubleshooting section	
	5	5.4-5.5	New support roller assembly and B.O.M. Removed door pivot roller pages and incorporated with support roller assembly.	
		5.7	Corrected rotary idler B.O.M.	
		5.16-5.17	New cage plate assembly and B.O.M.	
		5.24-5.25	Replaced motor & motor mount assembly & B.O.M.	

Continued on next page

Summary Of Revisions Continued				
Date	**Section**	**Page**	**Description Of Revision**	**Approved**
Nov 2011	5	5.28-5.29	Replaced tong door assembly & B.O.M.	S.Hargreaves
	6		Complete revision of torque measurement section	
Feb 2012	2	2.12	Corrected list of available tong jaw dies	
SEP 2012	Intro	xi	Inserted list of illustrations	D.Bowles
	2		Removed old subsection 2.H.2, "Initial Start-up & Break-in"	
		2.20	Inserted new subsection 2.H.2, "Operator Safety"	
		2.23	Inserted new subsection 2.H.5, "Pre-operational Checks"	
	3	3.21-3.22	Revised section 3.I, "Daily Inspection & Maintenance Checklist"	
		3.24-3.26	Revised section 3.I, "Monthly Inspection & Maintenance Checklist"	
			Removed old Section 2.K, "Power Unit Daily Inspection & Maintenance"	
		3.27-3.31	Revised Section 2.L, "Tubular Connection Equipment Decommissioning" & re-named "Tubular Connection Equipment Decommissioning and Shipping"	
	4	4.1	Revised Section 4.A, "Troubleshooting - Tong Will Not Develop Sufficient Torque"	
		4.2	Inserted new Section 4.B, "Troubleshooting - Relief Valve Incorrectly Set"	
		4.4	Inserted new section 4.C, Troubleshooting - Safety Door	
	6	6.7	Inserted new subsection 6.C.3, Reference Checking Torque Measurement System	

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The information presented in this document will provide setup, operating, and maintenance instructions for your KT5500 tong & CLINCHER® backup. Due to the wide variety of operating conditions, these instructions must be considered guidelines rather than absolute operating procedures. It is the responsibility of the user to use these guidelines together with an experienced manager to develop operating procedures that conform to all policies set forth by the operating authority (ies).

IDENTIFICATION OF OF WARNINGS AND OTHER NOMENCLATURE OF IMPORTANCE USED IN THIS INSTALLATION GUIDE

McCoy Drilling & Completions uses three indicators to describe items of three degrees of importance.

*A **HAZARD** to operators or equipment is represented by an exclamation point within a red triangle and identifies items of the highest importance. Failure to heed information identified by a **HAZARD** symbol may result in bodily injury, death, catastrophic equipment damage, or any combination of these. A **HAZARD** may also indicate the potential for dangerous environmental contamination.*

This identifies a HAZARD to operators or equipment

*A **WARNING** is represented by an exclamation point within an orange triangle, and contains information that will alert personnel to a potential safety hazard that is not life-threatening. A **WARNING** may also serve to alert the user to information critical to the correct assembly or operation of the equipment in use.*

This identifies a WARNING to users

*A **CAUTION** is represented by an exclamation point within a yellow triangle and highlights information that may aid the user during assembly or operation of your equipment. CAUTIONs are also used to ensure common errors are not made during assembly or operation of your equipment.*

This identifies a CAUTION to users

Observance of the following is the full responsibility of the user:

- ***all descriptions, information and instructions set out in this manual***
- ***any regulation or requirement issued by an authority or agency which may influence operation, safety or integrity of the equipment that overrules the content of this document.***
- ***any legal or other mandatory regulation in force governing accident prevention or environmental protection.***

Congratulations on the purchase of your FARR® KT5500 5-1/2" tong and CLINCHER® backup. This unit will provide you with years of outstanding performance. Simple maintenance and care will extend its life and ensure years of excellent performance and reliability. The setup, operating, and maintenance instructions in this manual will assist you in giving your equipment the care it requires. Please carefully read the manual before installing and using your equipment. Replacement parts are readily available from McCoy Drilling & Completions | FARR in Edmonton Alberta. Note that many parts are transferable between FARR® tongs and backups. Should you need replacement parts, or should you experience any difficulty not covered in this manual, please contact:

McCoy Drilling & Completions | FARR

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ILLUSTRATION 1.A.1: KT5500 TONG & CLINCHER© BACKUP (MODEL 80-0421-3 SHOWN)

Model 80-0421-3 Shown

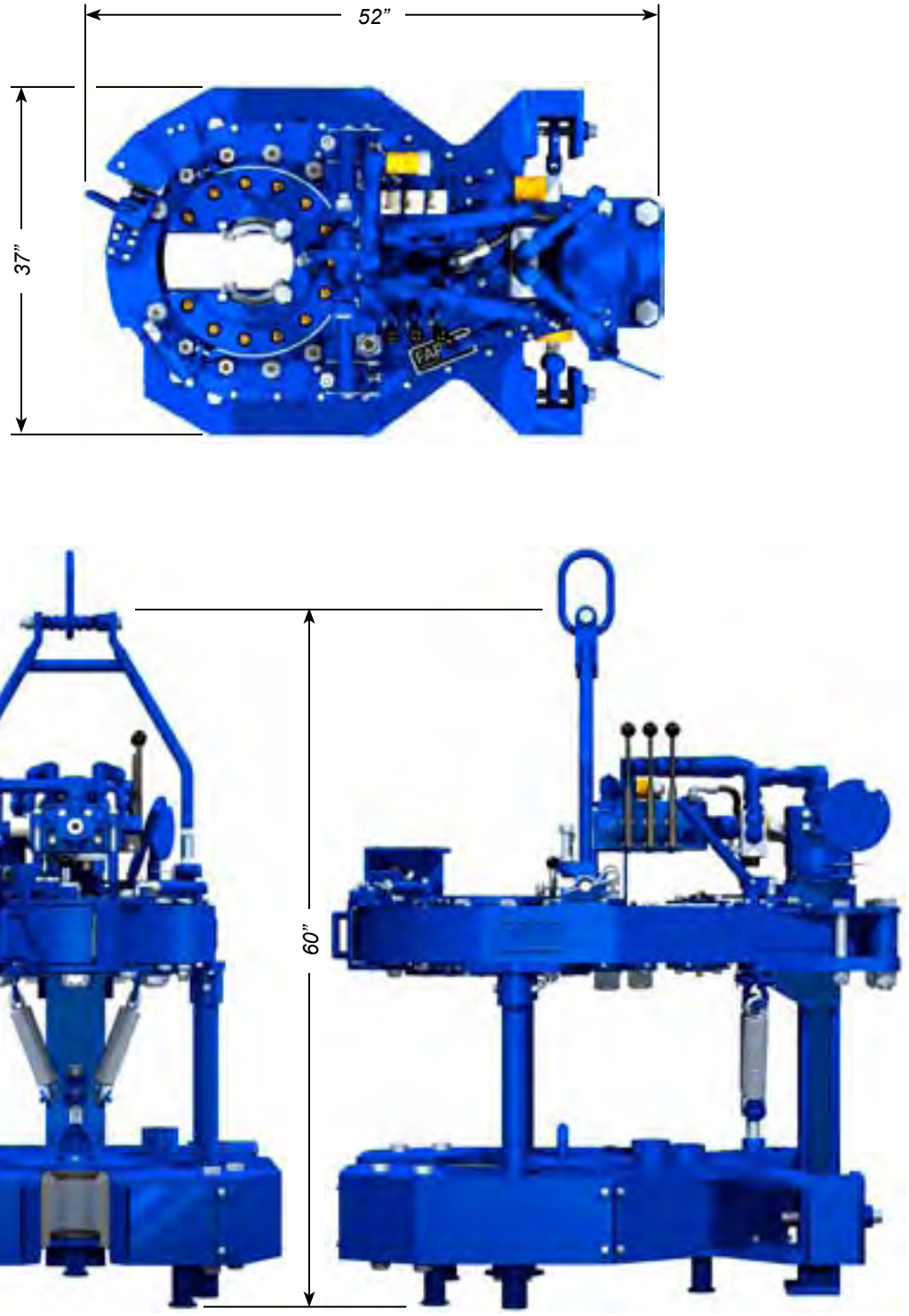

ILLUSTRATION 1.A.2: KT5500 TONG & CLINCHER© BACKUP DIMENSIONS

Torque Table **				
Pressure	High Gear		Low Gear	
PSI / MPa	Lbs.-ft.	Nm	Lbs.-ft.	Nm
1000 / 6.89	1530	2074	7650	10372
1400 / 9.66	2250	3050	11250	15253
1800 / 12.41	2970	4027	14845	20127
2250 / 15.513	3780	5125	18894	25617
MAXIMUM RATED TORQUE: 18700 LBS.-FT. / 25354 Nm				

Speed Table (Single Speed Motor)		
Flow (US GPM / LPM)	Low Gear (RPM)	High Gear (RPM)
10 / 37.9	2.7	13.4
20 / 75.71	5.4	26.8
40 / 151.4	10.7	53.6
60 / 227.1	16.1	80.5

** These are ideal values. Actual achieved torque is highly dependant upon tong efficiency and final position of rotary gear when full torque load is reached.

Maximum Hydraulic Requirements: 60 US GPM (227.1 LPM)
2500 psi (17.2 MPa)

Length (Doors Closed): 52" inches / 132.1 cm

Height: 60" / 152.4 cm

Width: 37" / 94 cm (Model 80-0421-3 Tension LC)
34" / 89 cm (Models 80-0422 & 80-0406 Comp. LC)

Torque Arm Length: 30 inches / 76.2 cm (Tension Load Cell Configuration)
32 inches / 81.3 cm (Compression Load Cell Configuration)
- Centre line of pipe to centre line of anchor -

Weight (Approximate, without jaws): 2050 lb. / 932 kg.

Recommended Spring Hanger: 85-0106XXH (Capacity = 3500 lbs./1591 kg.)

Casing Jaws Available (inches): See Pp. 2.12 - 2.14

ALL REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

Use an EP synthetic grease that meets or exceeds the following specifications:

Thickener	*Lithium Complex*
NLGI consistency grade	*2*
NLGI performance grade	*GC-LB*
Penetration - ASTM D 217 (25°C [77°F]	*265-295 minimum 0.1 mm) worked 60 strokes*
Dropping point, °F[°C] - ASTM D2265	*550 [288] minimum*
High temperature life, hours - ASTM D 3527	*160 minimum*
Oxidation stability, psi - ASTM D 942	*(100 hr/300 hr) 0/3*
Water washout, percent - ASTM D 1264	*1.8 max*
Rust and corrosion - ASTM D 1743	*pass*
Oil separation, percent loss - ASTM D 1742	*1.1 max (24 hours, 25°C [77°F]*
Leakage, g lost - ASTM D 4290	*1.0 max*
Four ball wear test, mm scar - ASTM D 2266	*0.40 max*
Fretting wear, mg - ASTM D 4170	*3.4 max*
Four ball EP, kgf - ASTM D 2596:	
Weld point:	*400 minimum*
Load wear index:	*50 minimum*
Timken OK load test, lbs - ASTM D 2509	*50*
*Low temperature torque, N*m - ASTM D 4693*	*1.3 max (-40°C [-40°F])*
LT-37 pumpability, g/min	*360/7 (60°F/0°F [16°C/-18°C])*
Copper corrosion - ASTM D 4048	*1B*
Oil viscosity: 40°C [104°F], cSt	*151*
100°C [212°F], cSt	*19.2*
Flash point, °F[°C] - ASTM 92	*450[232]*

Use a premium quality hydraulic fluid that meets or exceeds the following specifications:

Typical Density (kg/m3)	*878*
Viscosity - cSt @ 40 °C	*68.8*
- cSt @ 100 °C	*8.7*
Viscosity Index	*97*
Pour Point °F [°C]	*-22 [-30]*
Flash Point °F [°C]	*432 [222]*
Colour, ASTM	*1.5*
Neutralization Number	*0.40*
Rust Protection - Distilled Water	*No Rust*
- Sea Water	*No Rust*
Hydrolytic Stability - Cu Mass Loss, mg/cm2	*0.04*
Copper Corrosion Test	*1A*
Filterability: Denison - Wet & Dry	*Pass*
Afnor - Wet & Dry	*Pass*
Cincinatti Milacron Spec Approved	*P69*
Denison HF-0:	*Approved*
Denison P-46 Piston Pump:	*Pass*
Denison T6C Vane Pump:	*Pass*
Vickers 35VQ25 Vane Pump Test:	*Pass*
Vane pump test total ring and vane wear, mg.	*<10*

Oxidation Stability:	
Turbine Oil Stability Test Life, hours	*2500+*
Rotary Bomb Oxidation Test, minutes	*325*
FZG Spur Gear Test, Failure Load Stage (FLS)	*12*

Adequate setup and proper hydraulic connections are essential in ensuring reliable operation of your tong. For best results and long term reliability, read and obey the start-up instructions in this section.

DO NOT ACCESS ROTATING COMPONENTS UNLESS HYDRAULIC POWER SUPPLY HAS BEEN DEACTIVATED OR ISOLATED.

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

A. SLING / LOAD BEARING DEVICE SAFETY

THE SUPPLIED LOAD-BEARING DEVICE (CHAIN SLING, RIGID SLING, SPREADER BAR ASSEMBLY, FRAME, OR ANY OTHER DEVICE THAT BEARS THE PARTIAL OR TOTAL WEIGHT OF THE EQUIPMENT DESCRIBED IN THIS MANUAL) HAS BEEN SPECIFIED OR DESIGNED TO SUPPORT THE EQUIPMENT DESCRIBED IN THIS DOCUMENT. FARR WILL NOT GUARANTEE THE ABILITY OF THE LOAD-BEARING DEVICE TO SUPPORT ANY OTHER PART, ASSEMBLY OR COMBINATION OF PARTS AND ASSEMBLIES, OR ANY ADDITIONS TO THE EQUIPMENT DESCRIBED IN THIS MANUAL THAT ADD WEIGHT TO THE EQUIPMENT, UNLESS SUPPLIED BY MCCOY DRILLING & COMPLETIONS.

MCCOY DRILLING & COMPLETIONS DOES NOT GUARANTEE THE INTEGRITY OF MODIFIED OR DAMAGED LOAD-BEARING DEVICES, UNLESS THOSE MODIFICATIONS ARE PERFORMED BY MCCOY DRILLING & COMPLETIONS.

McCoy Drilling & Completions recommends following an industry-accepted standard such as OSHA, ASME B30.9-2006, or manufacturer's guidelines when performing any rigging and overhead lifting. Use by untrained persons is hazardous. Improper use will result in serious injury or death. Do not exceed rated capacity. Slings will fail if damaged, abused, misused, overused, or improperly maintained.

- *Only grade 80 or grade 100 alloy chain should be used for overhead lifting applications.*
- *Working Load Limit (WLL) is the maximum allowable load in pounds which may be applied to the load-bearing device, when the device is new or in "as new" condition, and when the load is uniformly and directly applied. The WLL must never be exceeded.*
- *Working Load Limit (WLL) is the maximum working load for a specific minimum sling angle, measured from the horizontal plane. The Working Load Limit is identified on the sling.*
- *The Working Load Limit or Design factor may be affected by wear, misuse, overloading, corrosion, deformation, intentional alterations, sharp corner cutting action and other use conditions.*
- *Shock loading and extraordinary conditions must be taken into account when selecting alloy chain slings.*
- *See OSHA Regulation for Slings 1910.184, ANSI/ASME B30.9-"SLINGS", ANSI/ASME B30.10-"HOOKS" and ANSI/AMSE B30.26 "RIGGING HARDWARE" for additional information.*

THE MINIMUM SLING ANGLE (THE ANGLE OF THE LEG OF THE SLING MEASURED FROM THE HORIZONTAL) MUST NEVER FALL LOWER THAN THE ANGLE SPECIFIED FOR THE SLING IN USE

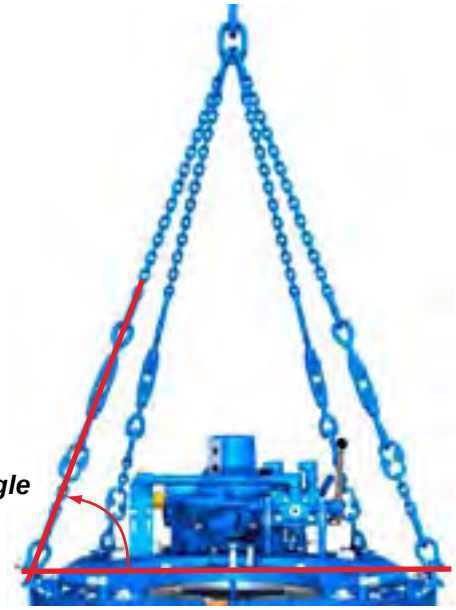

ILLUSTRATION 2.A.1: SLING ANGLE

1. **Inspection Of Slings**

McCoy Drilling & Completions strongly recommends the following practices:

A complete inspection of new load-bearing devices and attachments shall be performed by a qualified, designated person prior to initial use. Each link and component shall be examined individually, taking care to expose and examine all surfaces including the inner link surface. The sling shall be examined for conditions such as those listed in the removal criteria below. In addition, daily inspection of slings, fastenings and attachments shall be performed by a designated person. If damage or defects are found at either inspection, the damaged or defective component shall be quarantined from service until it can be properly repaired or replaced.

Removal Criteria:

A load-bearing device shall be removed from service if conditions such as the following are present:

- *Missing or illegible sling identification.*
- *Cracks or breaks*
- *Evidence of tampering is seen - sling tag has been modified or obscured, or tamper-proof nuts are missing.*
- *Signs of impact on load-bearing components, including spreader bars, lifting lugs, rigid slings & rigid sling weldments, and legs & leg mounts.*
- *Broken or damaged welds.*
- *Excessive wear, nicks, or gouges. Refer to the chart below to ensure minimum thickness on chain links supplied is not be below the values listed:*

Minimum Allowable Chain Link Thickness at Any Point			
Nominal Chain Size		Minimum Thickness	
Inches	MM	Inches	MM
7/32	5.5	0.189	4.80
9/32	7	0.239	6.07
5/16	8	0.273	6.93
3/8	10	0.342	8.69
1/2	13	0.443	11.26
5/8	16	0.546	13.87
3/4	20	0.687	17.45
7/8	22	0.750	19.05
1	26	0.887	22.53
1-1/4	32	1.091	27.71
Refer To ASME B30.9			

- *Stretched, bent, twisted, or deformed chain links or components.*
- *Evidence of heat damage.*
- *Excessive pitting or corrosion.*
- *Lack of ability of chain or components to hinge (articulate) freely.*
- *Weld splatter.*
- *For hooks, removal criteria as stated in ASME B30.10*
- *Other conditions, including visible damage, that cause doubt as to the continued use of the sling.*

Inspect all lugs and fixing points for signs of elongation and/or bending, or for material build-up around the hole. Repair or replace components that appear distorted. Ensure all hardware is tight and in good condition. Replace missing hardware if necessary. All hardware must be free of rust and corrosion.

Additional inspections shall be performed during sling use where service conditions warrant. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on:

- *Frequency of use of the load-bearing device.*
- *Severity of service conditions*
- *Nature of lifts being made*
- *Experience gained on the service life of load-bearing devices used in similar circumstances.*

Guidelines for the interval are:

- *Normal Service - yearly*
- *Severe Service - monthly to quarterly*
- *Special Service - as recommended by a qualified person*

Units designed and manufactured in accordance with EN 12079 and DNV 2.7-1 should be tested and examined in accordance with the following schedule of examination and test. The user of the load-bearing device shall place a permanent placard or plate upon which the type and date of the last test shall be recorded. To avoid confusion, the plate shall not carry the date of the next test or examination, only the most recent.

Test / Examination				
Time / Interval	Lifting Tests[1]	Non-Destructive Examination (NDE) of Lifting Points	Thorough Visual Examination	Suffix To Be Marked On Plate Attached To Unit
Initial Certification By Farr / Superior	YES	YES	YES	T
Interval Not Exceeding 12 Months	At the discretion of inspection body	At the discretion of inspection body	YES	T or VN[3]
Interval Not Exceeding 60 Months	At the discretion of inspection body	YES	YES	T or VN
Following Substantial Repair or Alteration	YES	YES	YES	T

1. Lifting test as per S 7.3 BS EN 12079 or DNV 2.7-1 May 1995
2. T = Proof Test, non-destructive examination; VN = non destructive examination and visual examination; V = visual examination.
3. Dependant upon whether non-destructive examination has been carried out.
4. For the purposes of this standard, a substantial repair or modification is defined as any repair and/or modification that has been carried out which may, in the opinion of the inspection body, affect the load-bearing elements of the container or lifting device, or elements that contribute directly to its structural integrity.

IF MECHANICAL DAMAGE IS SEEN OR SUSPECTED ON A LOAD-BEARING DEVICE, OR IF THE LOAD-BEARING DEVICE HAS BEEN OVERLOADED, IT MUST BE REMOVED FROM SERVICE AND QUARANTINED UNTIL RECERTIFIED

Written records of the most recent periodic inspection shall be maintained, and shall include the condition of the sling.

2. Proper Use Of Load-Bearing Devices

Whenever any load-bearing device is used, the following practices shall be observed.

- *Load-bearing devices that are damaged or defective shall not be used.*
- *Slings shall not be shortened with knots or bolts or other makeshift devices.*
- *Sling legs shall not be kinked.*
- *Load-bearing devices shall not be loaded in excess of their rated capacities.*
- *Slings shall be securely attached to their load.*
- *Load-bearing devices shall be protected from snagging, and shall not be further obstructed by any object.*
- *Suspended loads shall be kept clear of all obstruction.*
- *All employees shall be kept clear of loads about to be lifted and of suspended loads.*
- *Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.*
- *Shock loading is prohibited.*
- *Do not stand directly under a load during lifting.*

3. Storage Of Load-Bearing Devices

Proper storage of out-of-service load bearing devices is important to ensure full integrity of the device once it is returned to service. Farr recommends observing the following practices.

- *Wipe off all excess grease. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*
- *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces. Refer to manufacturer data sheets for proper application and safety information. Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*
- *Store in a clean, dry location. When returning to service, note that a full inspection of the device must be performed.*

B. MAJOR COMPONENT IDENTIFICATION

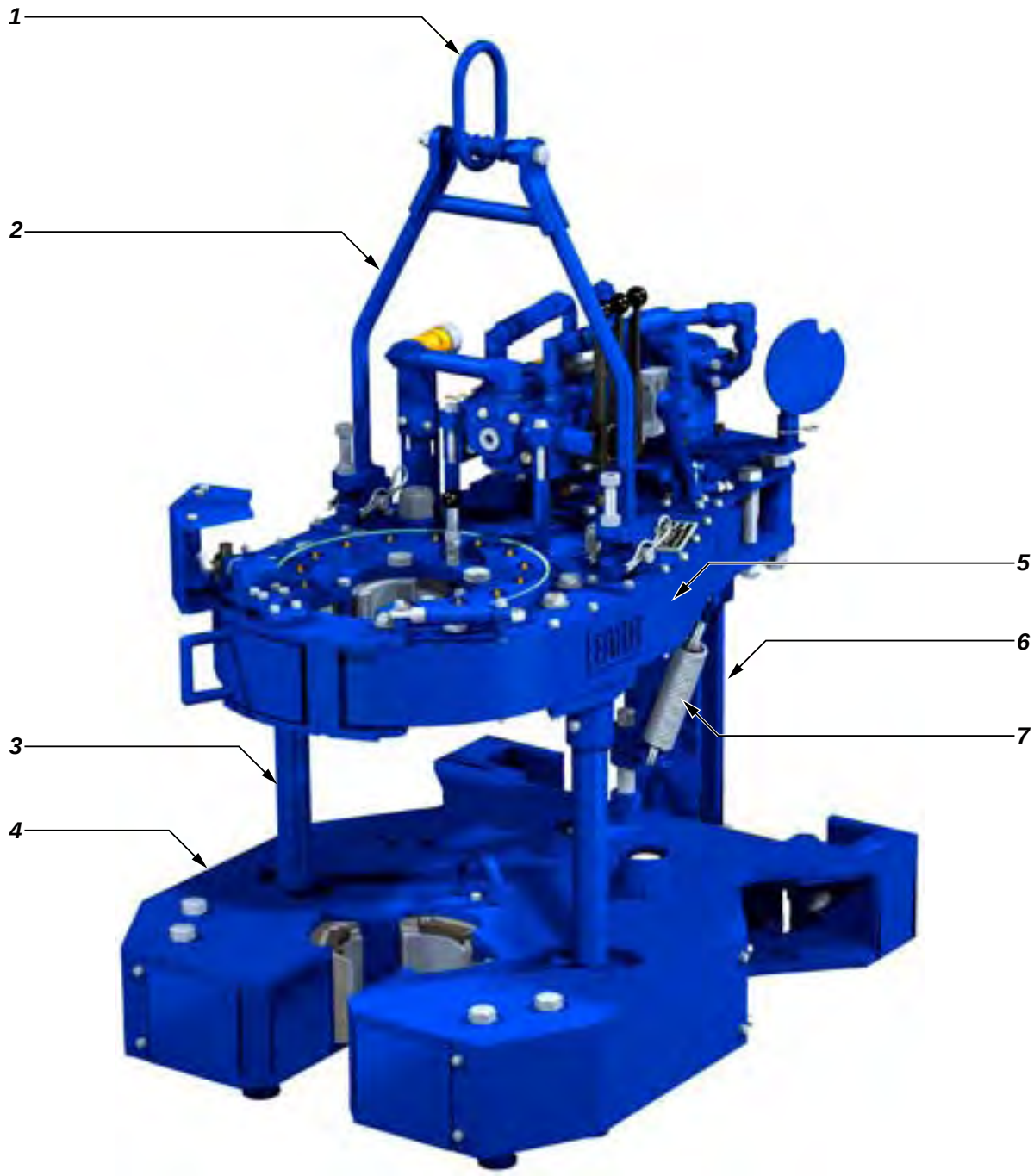

ILLUSTRATION 2.B.1: KT5500+CBU COMPONENT ID 01

Item	Description
1	Master Lifting Link
2	Rigid Sling
3	Front Leg Assembly
4	**CLINCHER®** Backup - Tension Load Cell Configuration
5	Power Tong
6	Rear Leg Assembly - Tension Load Cell Configuration
7	Rear Backup Spring Support Assembly

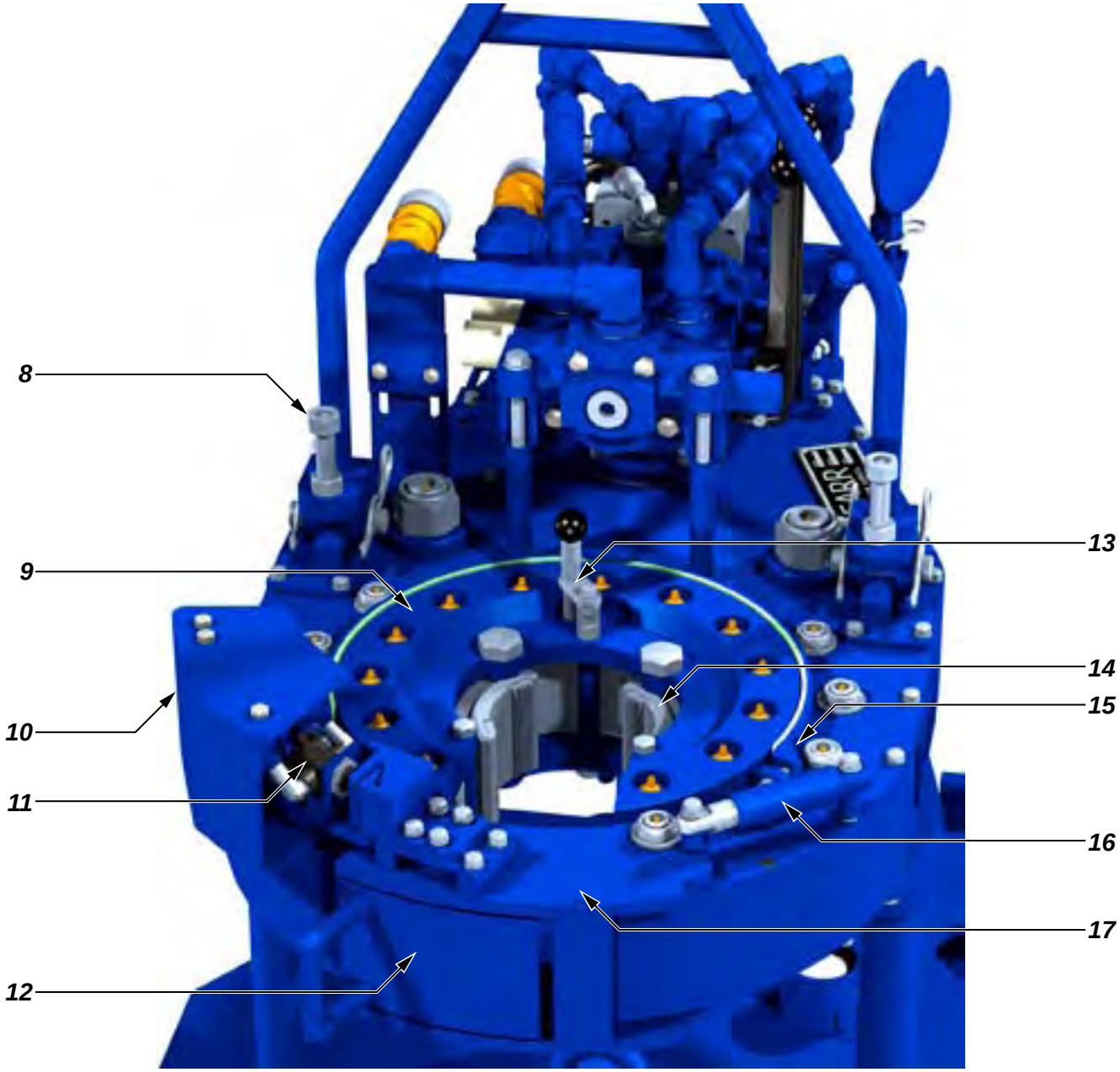

ILLUSTRATION 2.B.2: KT5500+CBU COMPONENT ID 02

Item	Description
8	Rigid Sling Leveling Device
9	Cage Plate Assembly
10	Safety Door Switch Guard
11	Safety Door Switch
12	Tong Door Latch
13	Backing Pin Assembly
14	Tong Jaws with Die Inserts
15	Brake Band Adjustment
16	Tong Door Cylinder
17	Tong Door Weldment

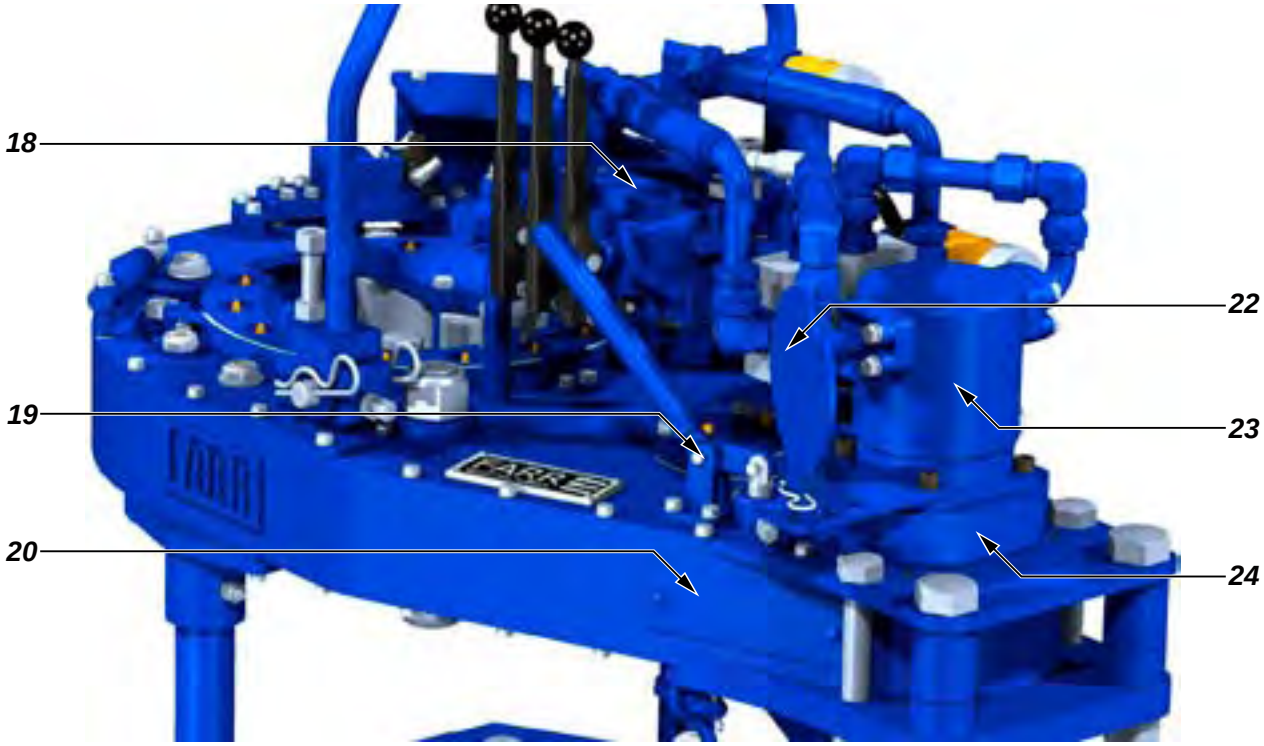

ILLUSTRATION 2.B.3: KT5500+CBU COMPONENT ID 03

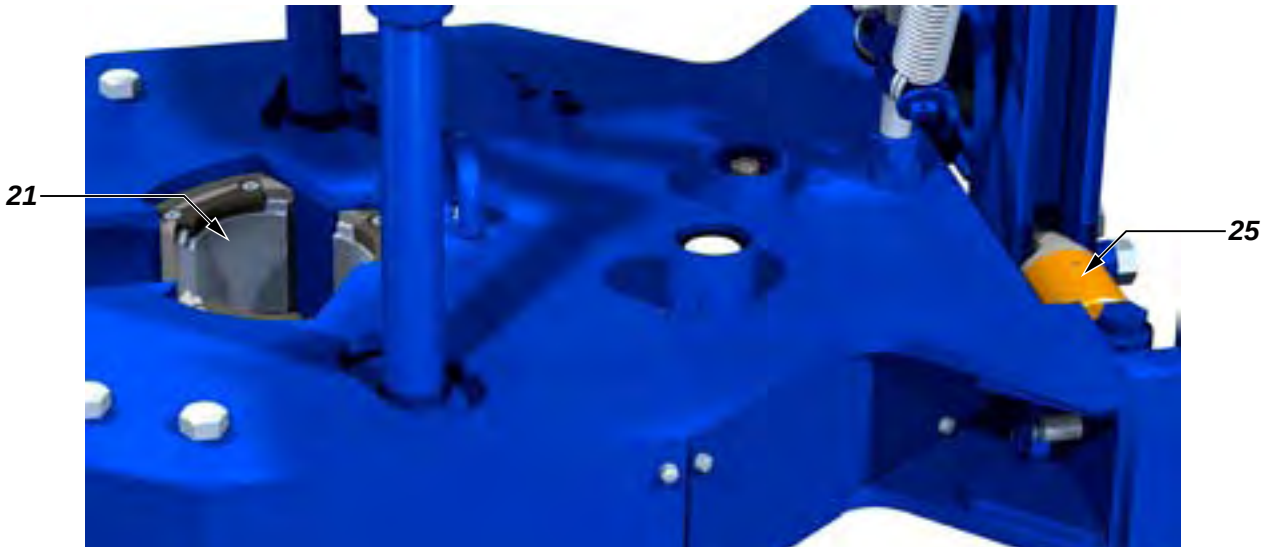

ILLUSTRATION 2.B.4: KT5500+CBU COMPONENT ID 04

Item	Description
18	Hydraulic Valve Bank Assembly
19	Manual Shift Assembly
20	Access Panel
21	**CLINCHER®** Cylinder With Wraparound Insert
22	Torque Gauge Mount
23	Hydraulic Motor
24	Motor Mount
25	Tension Load Cell

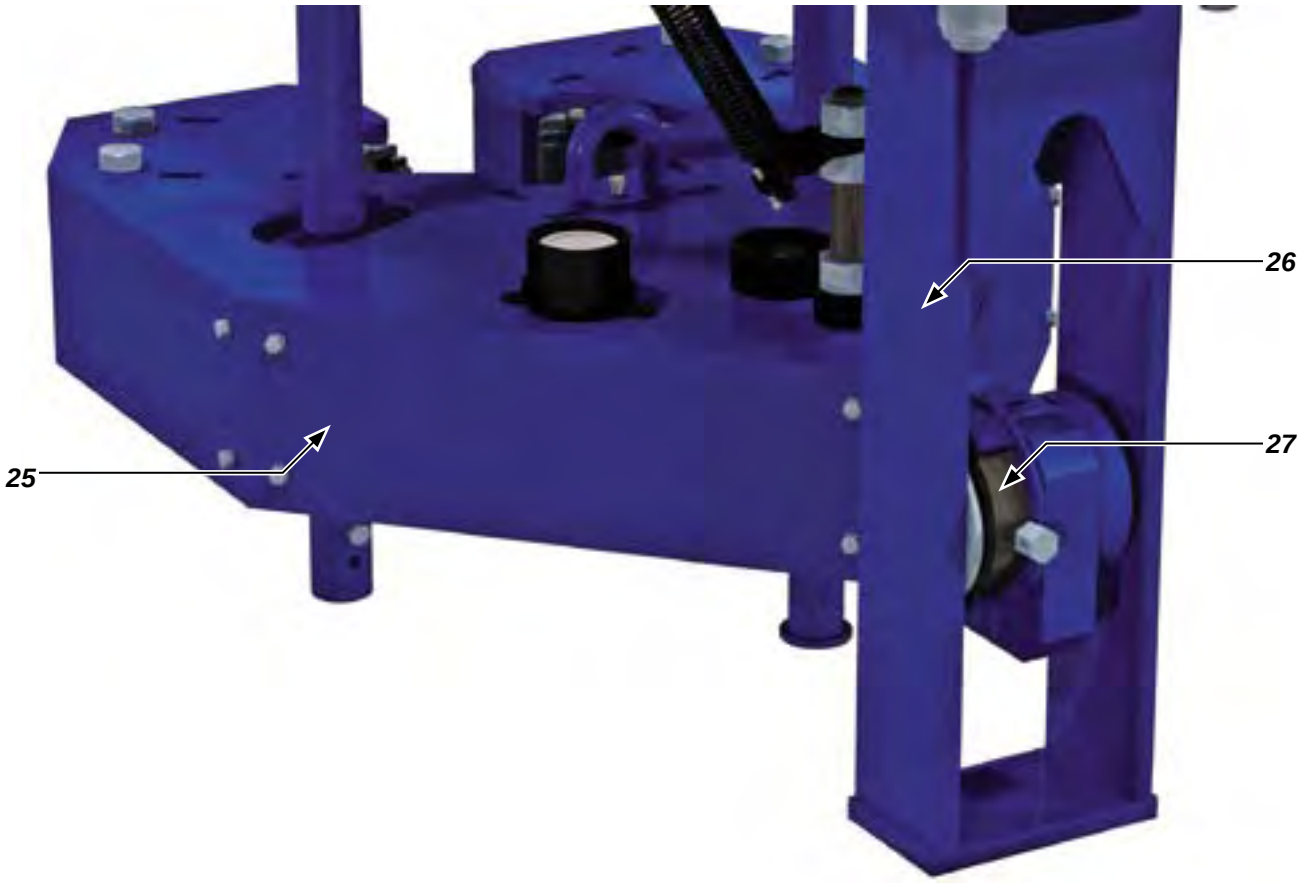

ILLUSTRATION 2.B.5: KT5500+CBU COMPONENT ID 05

Item	Description
25	***CLINCHER®** Backup - Compression Load Cell Configuration*
26	*Rear Leg Assembly - Compression Load Cell Configuration*
27	*Compression Load Cell*

C. HYDRAULIC SCHEMATIC / COMPONENT IDENTIFICATION

Your tong may be equipped with one or two control valves, as well as safety door switch and hydraulics, depending upon the specific model. Disregard the control valves indicated on the following schematics that do not apply to your model.

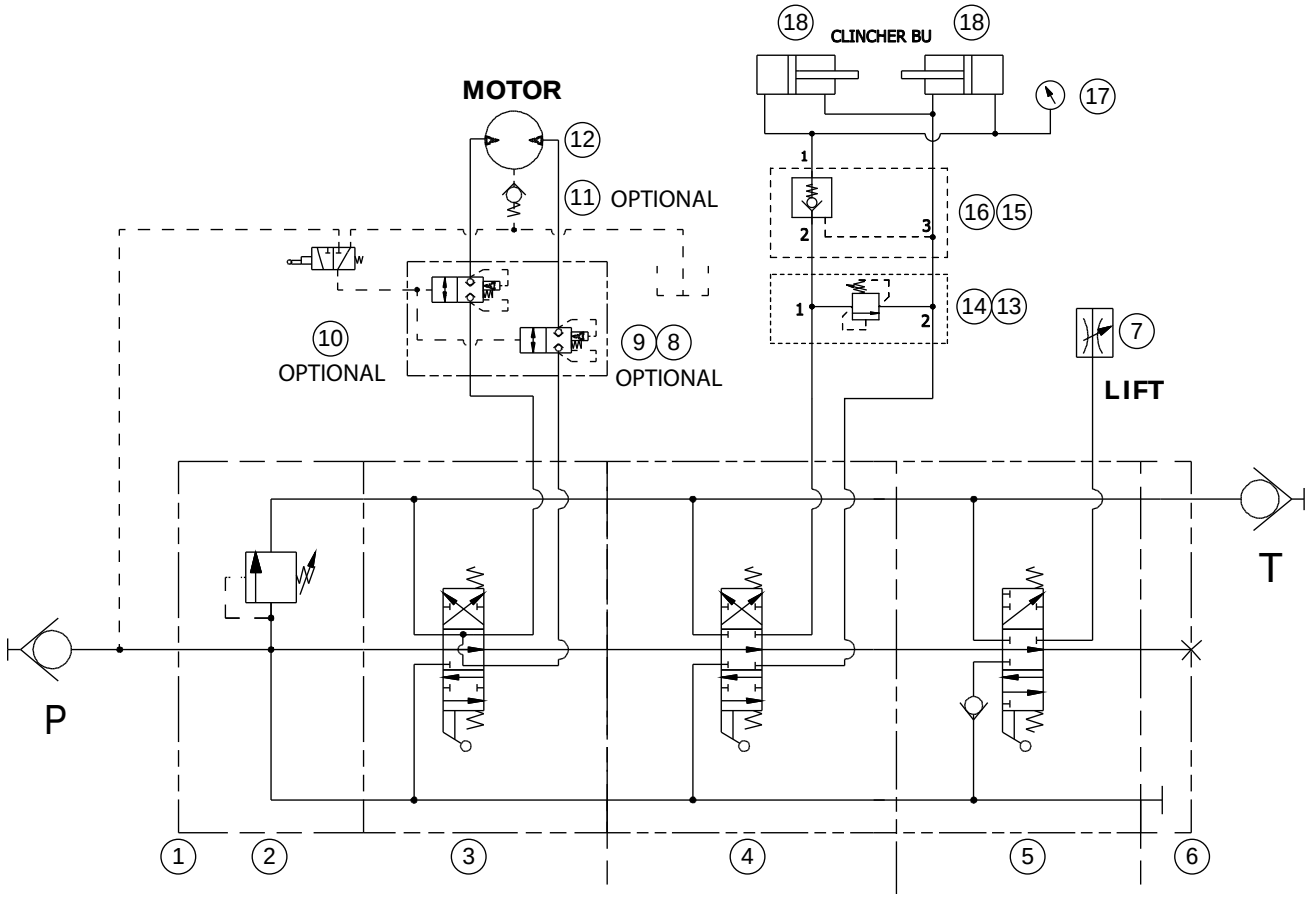

ILLUSTRATION 2.C.1: KT5500+CBU HYDRAULIC SCHEMATIC

Item	Description	Part Number
1	Inlet Valve DVA35-A880 w/2500 TO 3500 DVG35 HMRV CARTRIDGE	10-9016
2	Relief Valve, DVA35-MRV-1	10-0010R
3	Motor Section, DVA35-MA8, 4WAY SAE PORTS	10-9014
4	Backup Section, DVA35-DA8 4WAY SAE PORTS	10-9019
5	Lift Section, DVA-SA8, 1" ORB PORT	10-9015
6	Outlet Section, DVA35-TR99, SAE PORT	10-0086
7	Flow Control Valve, N800S (not shown)	08-9062
8	Pilot-To-Operate Cartridge Valve, LKHC-XDN	08-1625
9	Safety Door Valve Block	101-0727
10	Safety Door Switch	08-0337
11	Check Valve, SH4600	02-9022
12	Rineer GA15-13 Hydraulic Motor	87-0110
13	Relief Valve, RPGC-KAN	08-1180
14	Relief Valve Block, Sun CAJ	08-1844
15	Check Valve, CKEB-XCN	08-0481
16	Check Valve Block, Sun BCJ	08-1327
17	3000 psi Pressure Gauge	02-0245
18	**CLINCHER®** Backup Cylinder	1403-00-00B

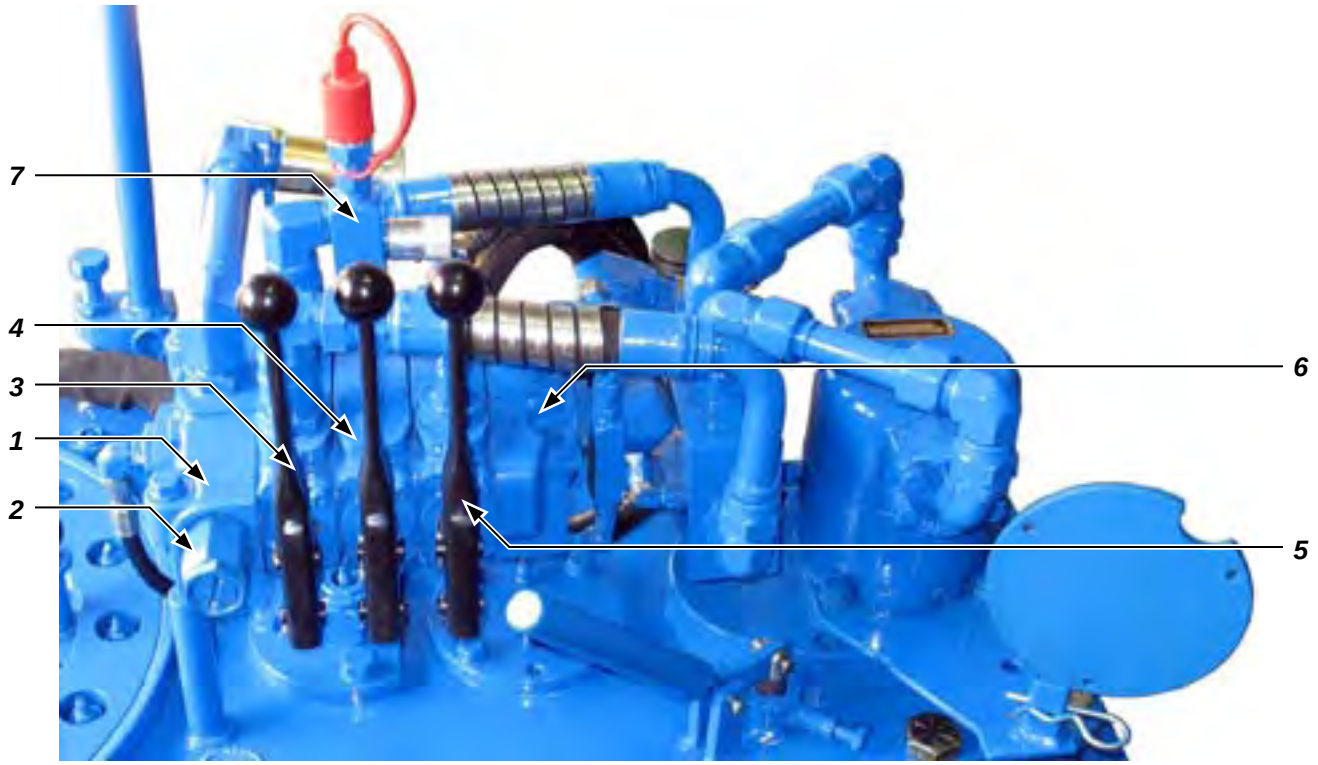

ILLUSTRATION 2.C.2: KT5500+CBU HYDRAULIC COMPONENT ID 01

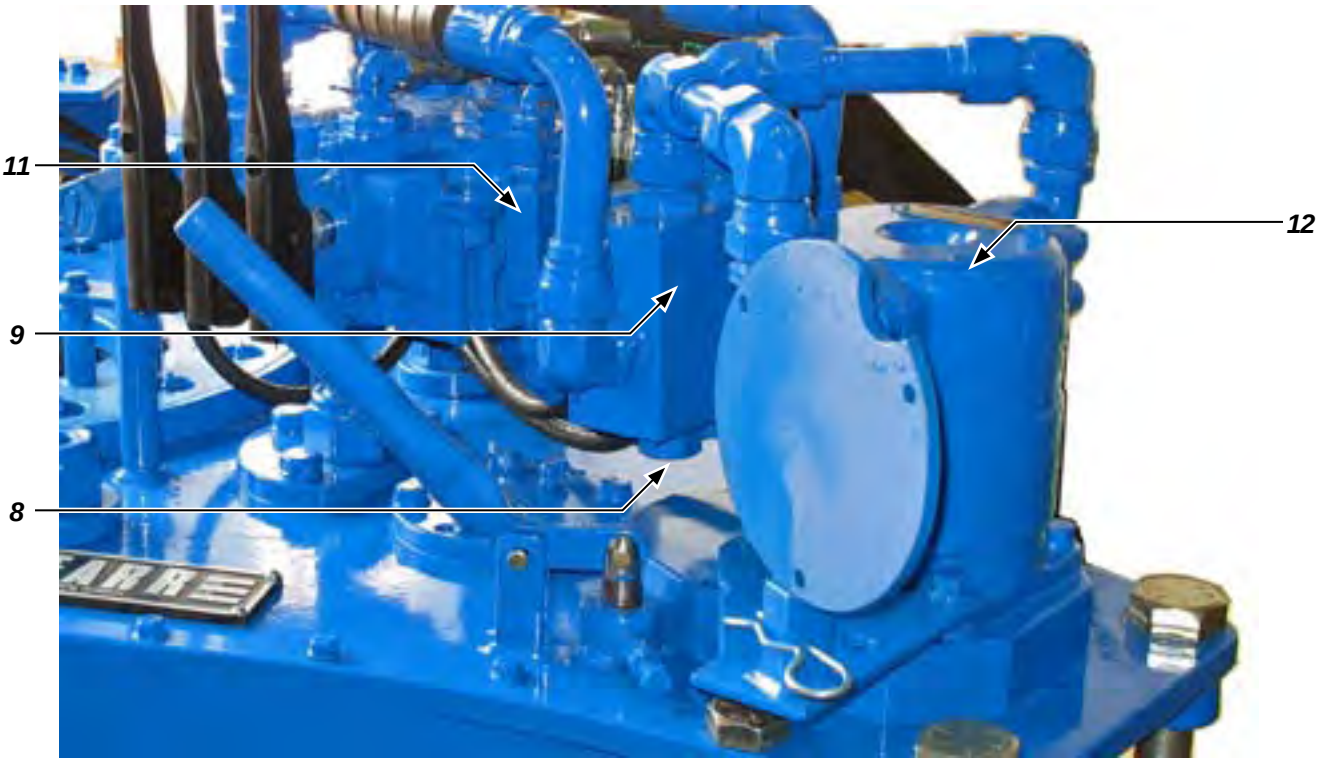

ILLUSTRATION 2.C.3: KT5500+CBU HYDRAULIC COMPONENT ID 02

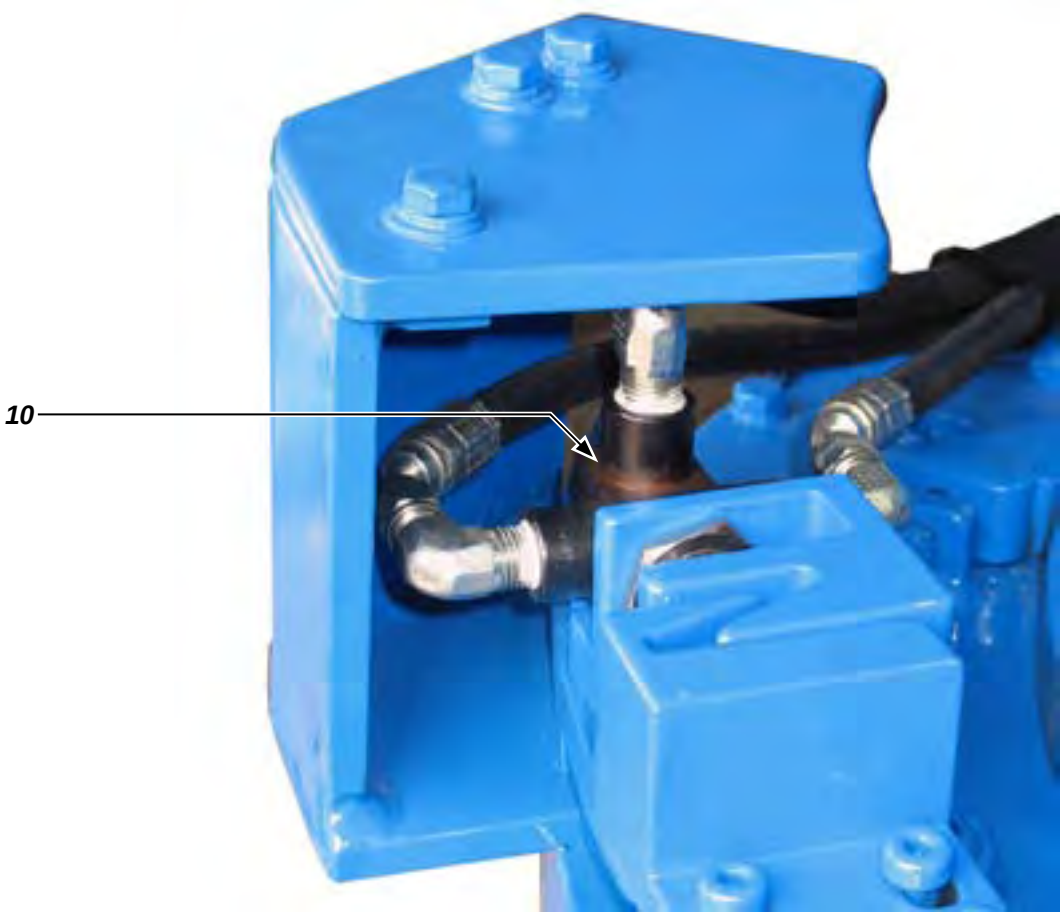

ILLUSTRATION 2.C.4: KT5500+CBU HYDRAULIC COMPONENT ID 03

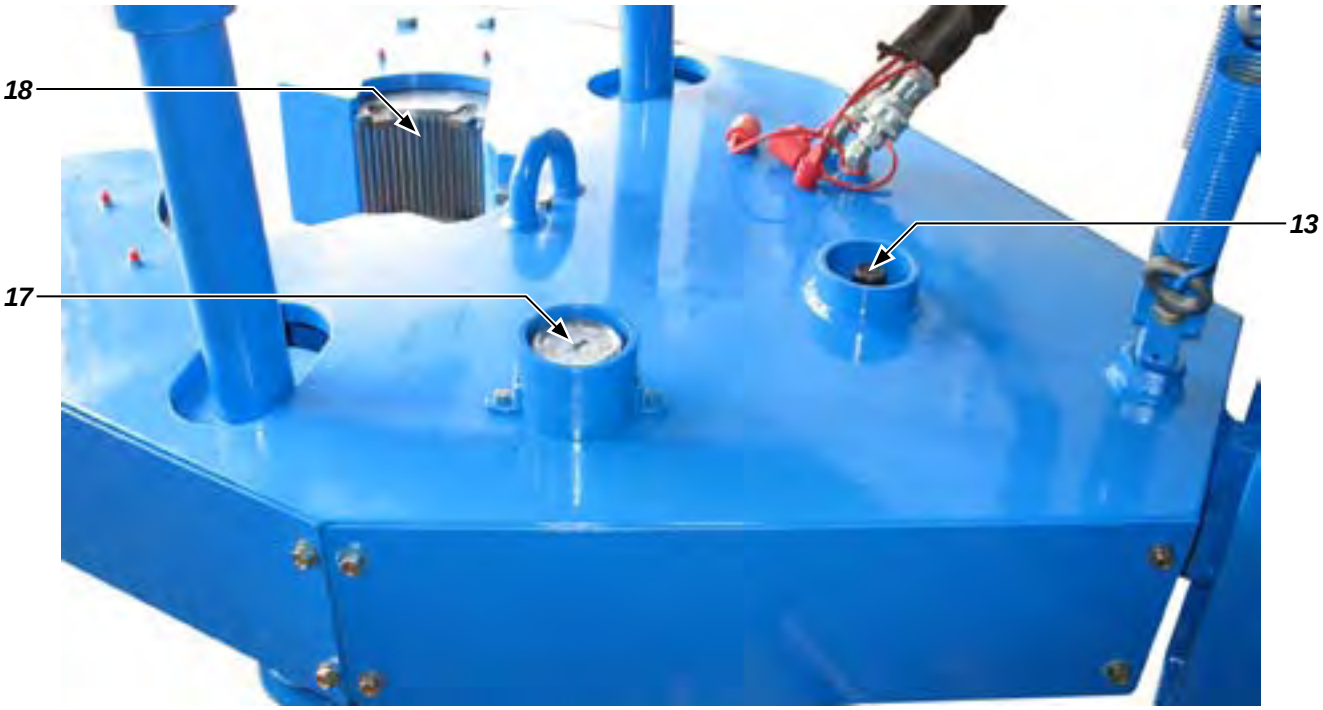

ILLUSTRATION 2.C.5: KT5500+CBU HYDRAULIC COMPONENT ID 04

ILLUSTRATION 2.C.6: KT5500+CBU HYDRAULIC COMPONENT ID 05

D. HYDRAULIC CONNECTIONS

A pair of hydraulic lines - a 1" supply line and a 1-1/4" return line - connect the tong to the power unit (see illustration below). Ancillary devices (hydraulic motors, hydraulic cylinders, etc.) are connected through the valve block.

Perform any hydraulic connection when the power unit is not running, or when the hydraulic pump is disengaged. The possibility of error in inter-changing the high pressure supply hose and the low pressure return hose has been eliminated, because the supply side coupling is smaller than the return side.

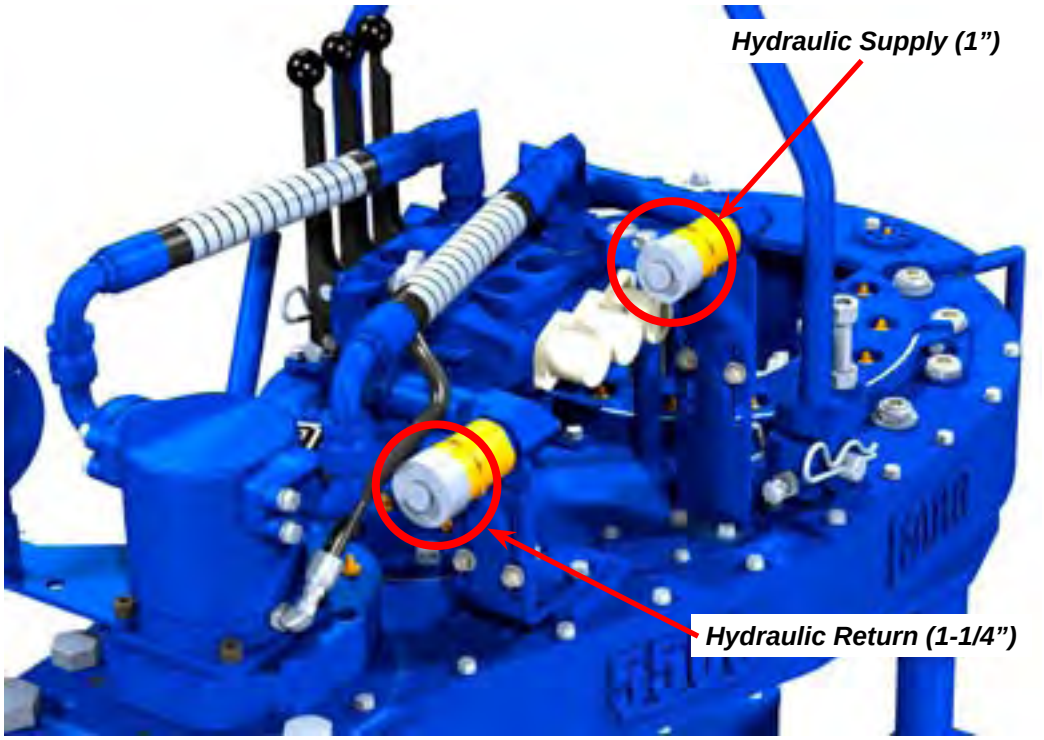

ILLUSTRATION 2.D.1: KT5500+CBU HYDRAULIC CONNECTIONS 01

These hose couplings are self-sealing, and care should be taken to ensure complete engagement to prevent partial closure of the check valve in the coupling. Ensure that the nut (female) side is completely made up onto the male connector - there is a line on the male fitting that indicates complete make-up. Snug the female fitting right up to the line.

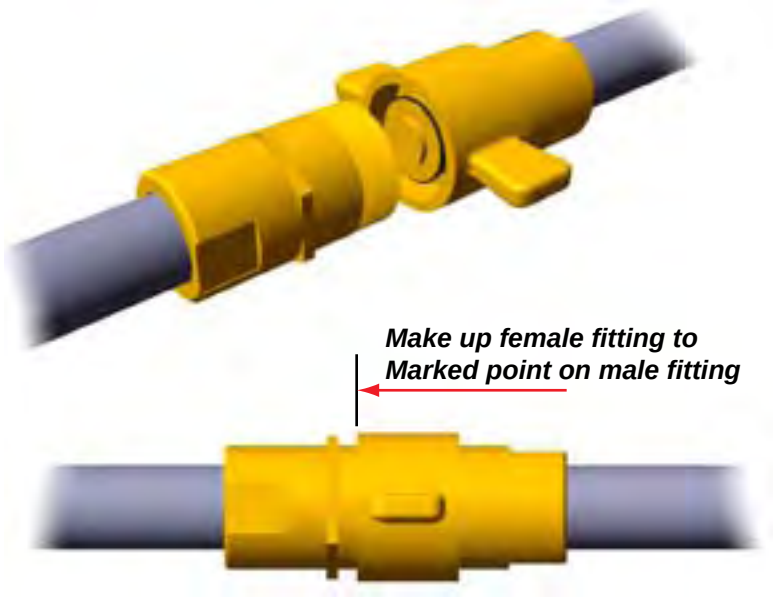

ILLUSTRATION 2.D.2: KT5500+CBU HYDRAULIC CONNECTIONS 02

E. TONG JAW AVAILABILITY & INSTALLATION

1. Jaw Availability

The following table lists all jaw die kits that are available as standard stocked sizes for this model of tong. McCoy Drilling & Completions | Farr offers a good selection of standard jaw sizes. However, please note that we can custom-engineer and manufacture any size of jaw within the range of the tong. Jaw systems are available to allow use of die inserts intended for specialized applications. Call our sales office for information on jaw and die systems designed for higher or lower grip, or non-marking applications.

The table lists standard contoured, flat and wraparound die inserts that are available as spare parts. However, a wide variety of diamond-tooth, GRITFACE®, aluminium, and wrap-around fine-tooth dies are available for specialized applications. Please refer to our website for complete information:

http://www.mccoyglobal.com/dies-inserts

STANDARD JAW DIE KITS (Inserts Not Included)	
Description	**Part Number**
2 - 3/8" Jaw Die Kit (1)	1064-JDK-65
2 - 7/8" Jaw Die Kit (2)	1064-JDK-70
3" Jaw Die Kit	1064-JDK-71
3 - 1/2" Jaw Die Kit	1064-JDK-75
4" Jaw Die Kit	1064-JDK-80
4 - 1/2" Jaw Die Kit	1064-JDK-85
5" Jaw Die Kit	1064-JDK-90
5 - 1/2" Jaw Die Kit (3)	1064-JDK-95
(1) Uses 2.375" Contour Die	12-0004
(2) Uses 2.875" Contour Die	12-0007
(3) Uses 1" x 3.875" Flat Die	12-0006-314-0
All other Standard Die Kits use 1-1/4" x 3.875" Flat Die	13-0008-314-0
Continued On Next Page	

WRAPAROUND JAW DIE KITS (Inserts Not Included)	
Description	**Part Number**
2-3/8" - 3-1/2" Wraparound Jaw Die Kit	1064-WJK-350
4" - 5-1/2" Wraparound Jaw Die Kit	1064-WJK-550
2-3/8" Wraparound Insert (for use in 1064-WJK-350)	12-2001
2-7/8" Wraparound Insert (for use in 1064-WJK-350)	12-2003
3-1/2" Wraparound Insert (for use in 1064-WJK-350)	12-2006
4" Wraparound Insert (for use in 1064-WJK-550)	12-2007
4-1/2" Wraparound Insert (for use in 1064-WJK-550)	12-2009
5" Wraparound Insert (for use in 1064-WJK-550)	12-2011
5-1/2" Wraparound Insert (for use in 1064-WJK-550)	12-2012

2. Jaw / Jaw Die Removal

The tong jaws will often require removal to change jaw size or replace worn jaw die inserts. Support the jaw being removed from the bottom, and use a wrench to loosen and remove the jaw pivot bolt. Slide the jaw away from the rotary gear towards the centre of the cage plate assembly, and lift clear of the tong. Repeat for the other jaw. Note that removal process for jaws with wraparound dies is identical.

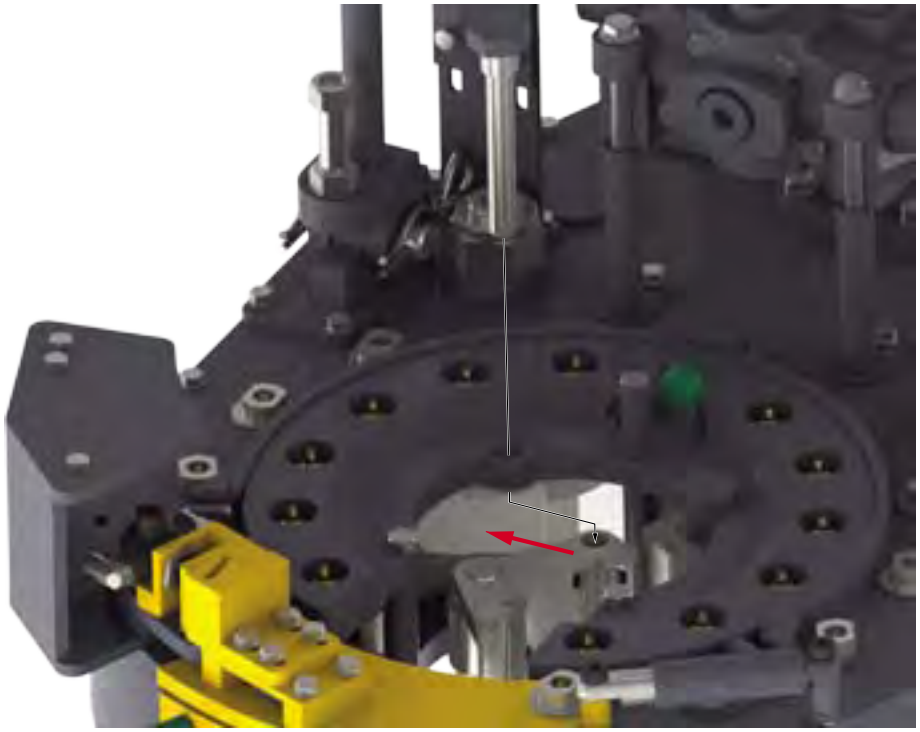

ILLUSTRATION 2.E.1: KT5500+CBU JAW REMOVAL

Removal and replacement of die inserts:

- *Removing the centre keeper screws*
- *Insert a narrow punch through the slot at the bottom of the jaw groove, and lightly tap the die from the bottom until it loosens enough to remove*
- *Reverse the process to install new jaw dies. Do not neglect to reinstall the keeper screws.*

(See illustration 2.E.2 next page)

2. Jaw / Jaw Die Removal (continued):

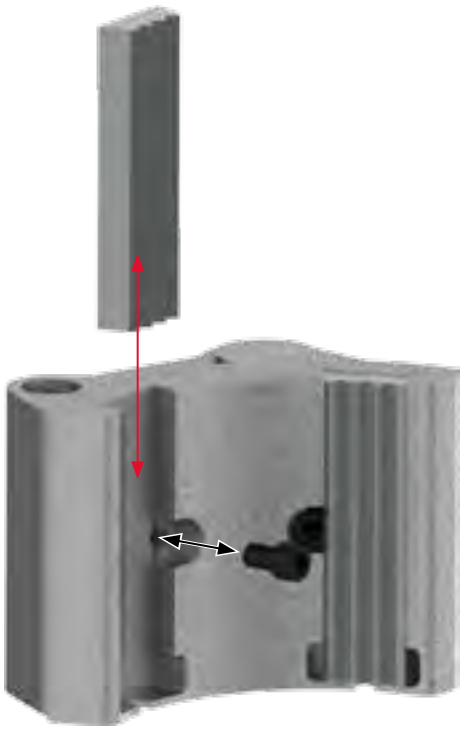

ILLUSTRATION 2.E.2: KT5500+CBU JAW DIE REMOVAL

3. Backup Jaw Availability

*The following table lists all inserts that are available as standard sizes for the 5-1/2" **CLINCHER®** backup. If your desired size is not listed, Farr can engineer custom jaw sizes - contact sales for further information.*

Description	Part Number		
2.375" **CLINCHER®** Backup Insert	12-6003	3.875" **CLINCHER®** Backup Insert	12-6118
2.375" **CLINCHER®** Backup Aluminum Insert	12-6120	4" **CLINCHER®** Backup Insert	12-6043
2.875" **CLINCHER®** Backup Insert	12-6007	4" **CLINCHER®** Backup Aluminum Insert	12-6130
2.875" **CLINCHER®** Backup Aluminum Insert	12-6113	4.125" **CLINCHER®** Backup Insert	12-6046
2.875" **CLINCHER®** Backup Insert (Grit)	12-6189	4.25" **CLINCHER®** Backup Insert	12-6094
3" **CLINCHER®** Backup Insert	12-6089	4.50" **CLINCHER®** Backup Insert	12-6051
3.125" **CLINCHER®** Backup Insert	12-6014	4.50" **CLINCHER®** Backup Aluminum Insert	12-6115
3.25" **CLINCHER®** Backup Insert	12-6019	4.75" **CLINCHER®** Backup Insert	12-6053
3.375" **CLINCHER®** Backup Insert	12-6022	5" **CLINCHER®** Backup Insert	12-6055
3.50" **CLINCHER®** Backup Insert	12-6027	5" **CLINCHER®** Backup Aluminum Insert	12-6116
3.50" **CLINCHER®** Backup Insert (Grit)	12-6027GF	5.20" **CLINCHER®** Backup Insert	12-6112
3.50" **CLINCHER®** Backup Aluminum Insert	12-6114	5.50" **CLINCHER®** Backup Insert	12-6057
3.6875" **CLINCHER®** Backup Insert	12-6032	5.50" **CLINCHER®** Backup Aluminum Insert	12-6117

4. CLINCHER® Backup Jaw Removal/Installation

i. *Extend **CLINCHER®** cylinders enough so that the hex flat-head cap screws securing the die retainer tabs are well exposed. Turn off hydraulic power.*

ILLUSTRATION 2.E.3: KT5500+CBU CLINCHER© CYLINDER EXTENSION

ii. *Remove the two hex flat-head cap screws securing the die retainer tab on the top of the **CLINCHER®** die.*

iii. *Remove the top die retainer tabs.*

iv. *Slide the die straight up, and remove.*

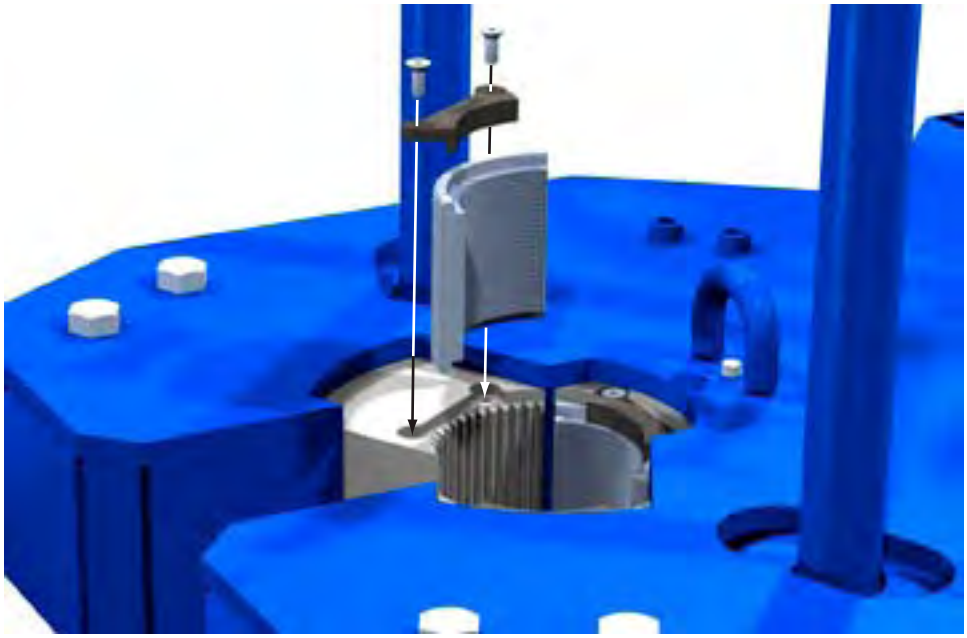

ILLUSTRATION 2.E.4: KT5500+CBU WRAPAROUND DIE REMOVAL / INSTALLATION

*To remove the die from the rear jaw, ensure both cylinders are retracted. Remove the hex bolt securing the rear jaw assembly, then slide rear jaw forward enough so that the flat-head cap screws securing the die retainer tab is well exposed. Remove the die following the same procedures as for the **CLINCHER**® cylinders.*

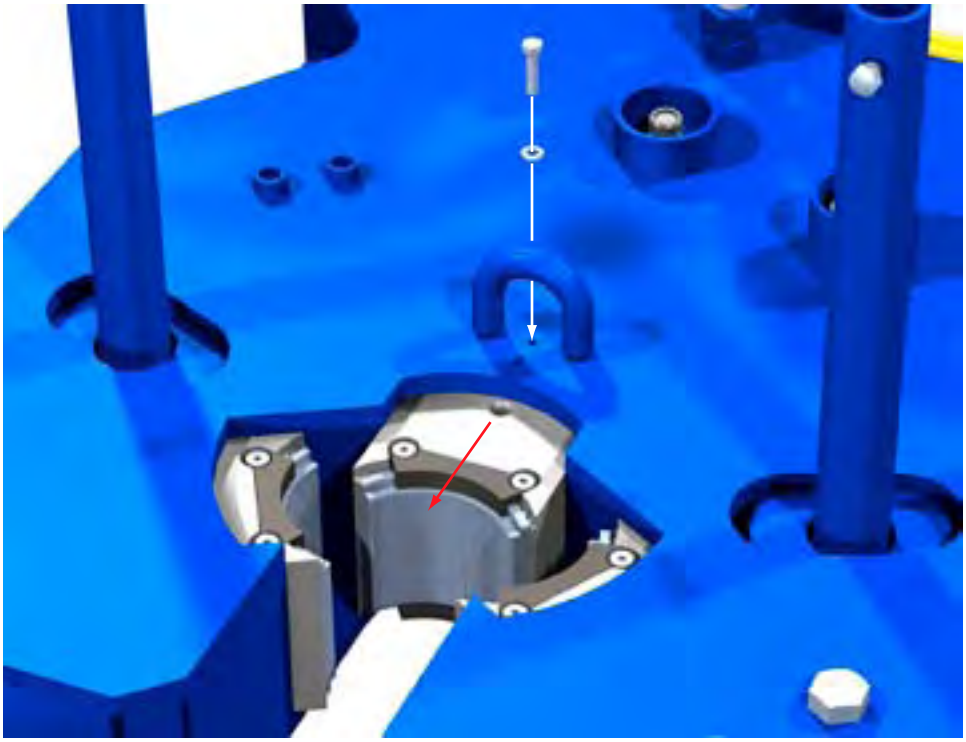

ILLUSTRATION 2.E.4: KT5500+CBU REAR BACKUP JAW EXTENSION

Reverse this procedure to install or replace jaws.

F. TONG RIG-UP & LEVELING

1. Suspension & Restraint

Suspend the tong and backup from a location as near to the centre of the drill rotary as possible, and from a location high enough on the mast to ensure easy handling. The lower the point from which the tong is suspended, the more effort will be required to move the tong and backup assembly on to and off the connection.

The suspension line may be extended over a pulley and balanced by a counterweight equal to the weight of the tong and backup, or simply tied off in the derrick to form a dead line. When using a dead line arrangement it is necessary to use a FARR spring hanger assembly (see specification page for recommended spring hanger). This spring hanger compensates for the downward movement of the casing as the thread is made-up, and imparts additional force to the suspension cable:

- *a "single spring" hanger typically applies 420 lbs. (191 kg.) to the suspension line for every inch of thread made up*
- *a "double spring" hanger typically applies 840 lbs. (382 kg.) to the suspension line for every inch of thread made up*

If you do not know which specific spring hanger is in use, check the specification page in this manual for information on the recommended spring hanger for this application. McCoy Drilling & Completions will not guarantee or specify spring hangers other than what has been supplied by McCoy.

Many applications use a lift cylinder for adjusting the height of the tong. Ensure the weight of the lift cylinder is known if it has not been included in the total weight of the tong.

All forces upon the suspension line must be considered when calculating necessary strength of the suspension line. The weight of the tong, the weight of the lift cylinder, the weight of the spring hanger, and the force imparted on the suspension line by the spring hanger must all be added together in order to arrive at the total force supported by the suspension line. Select your suspension line based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the suspension line and selection of the suspension line is the complete responsibility of the customer.

Suspension & Restraint (continued):

McCoy Drilling & Completions recommends using dual backup (snub) lines of sufficient strength to withstand the force imparted by the maximum rated torque of the tong and backup assembly in use. The snub lines will arrest uncontrolled movement of the tong and backup in the event slipping of the backup jaws. Calculate the force on the snub lines by dividing the maximum torque of the tong by the tong's torque arm (expressed in feet). For example, a 25,000 lbs.-ft. tong with a 32 inch (2.667 ft.) torque arm will generate 9375 lbs. of force against the snub line. Select your snub lines based upon the total force and the margins of safety dictated by the policies of your company and by established engineering practices. Ultimately, calculating the force on the snub line and selection of the snub line is the complete responsibility of the customer.

Snub lines must be securely connected to the rear of the tong and backup assembly, and tied off to a suitable anchor.

MCCOY DRILLING & COMPLETIONS ACCEPTS NO RESPONSIBILITY FOR DESIGNING AND SELECTING AN ADEQUATE SUSPENSION AND RESTRAINT SYSTEM FOR YOUR DRILLING EQUIPMENT

ALL SELECTED FASTENERS, SHACKLES, CLAMPS, ETC. USED FOR CONSTRUCTING THE SUSPENSION AND SNUB LINES MUST BE RATED FOR THE CALCULATED FORCES.

2. *Tong Leveling*

The tong must be leveled side-to-side and front-to-rear before placing into service. The following guidelines wil assist you when leveling your tong.

i. Place a level axially (side to side) across the tong, ensuring that it is parallel with the surface of the tong. Use a thin wrench on the flat of the adjusting helix to rotate the helix, forcing the lift link to move towards the outer supports of the sling. The 1" jam nut on the pin may have to be slightly loosened to allow the helix to rotate. Adjust the helix until the level shows that the tong is level side-to-side - retighten the nut if necessary

ILLUSTRATION 2.F.1: TONG LEVELING (SIDE-TO-SIDE)

Tong Leveling Continued:

ii. Place a level lengthwise (front to back) along the tong, ensuring that it is parallel with the surface of the tong. Loosen the 3/4" jam nuts on the adjusting bolts on rigid sling brackets. Completely loosen the adjusting bolts. Turn each adjusting bolt equally until tong hangs level front-to-back. Lock adjusting bolts in place with the jam nuts.

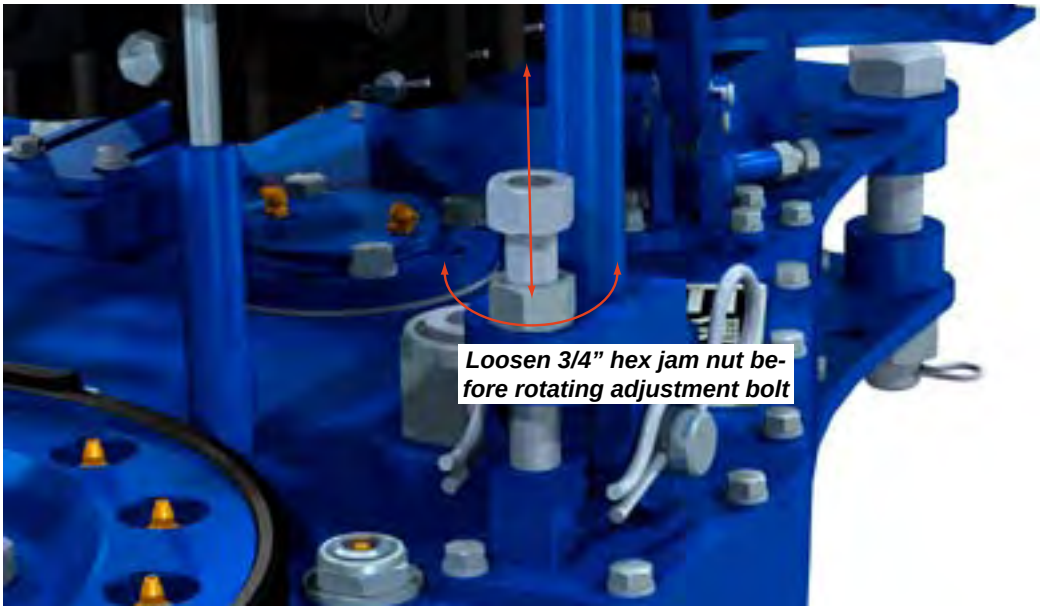

ILLUSTRATION 2.F.2: TONG LEVELING, FRONT-TO-BACK

3. Compression Load Cell Configuration

The backup is directly coupled to the compression load cell via the backup body paddle. The load cell hanger is simply hung on the paddle and secured through the top of the "U" by a bolt and washer set, and in normal operation does not need to be adjusted or removed. The assembly in the first of the following two illustrations has been configured in the "make-up" configuration; to convert the assembly to the "break-out" configuration remove the bolt and washer set securing the load cell holder to the paddle, and move the entire assembly to the other side of the paddle.

ILLUSTRATION 2.F.3: LOAD CELL CONFIGURATION, MAKE-UP

Compression Load Cell Configuration (continued):

ILLUSTRATION 2.F.4: LOAD CELL CONFIGURATION, BREAK-OUT

4. *Tension Load Cell Configuration*

The backup is coupled to the rear leg of the assembly with a tension load cell on one side, and a restraint chain on the other. To change the torque measurement configuration (make up to break out or visa versa) simply remove the heavy duty bolts securing the load cell and restraint chains, and switch to the opposite sides. Reinstall the heavy duty bolts to secure the load cell and restraint chains in place. For your reference the assembly in the following illustration has been configured to measure make up torque. If measurement of break out torque is desired the load cell would be connected between the right hand side of the rear leg and the backup.

ILLUSTRATION 2.F.5: TENSION LOAD CELL CONFIGURATION

H. TONG OPERATION

1. Operator Training

Many companies set qualification standards that must be met before equipment may be operated without supervision. McCoy Drilling & Completions recommends operator training, which typically consists of operation of the equipment under the supervision of a trained equipment operator until a satisfactory level of competence is achieved. Typical operator training should include:

- *Introduction to and general description of equipment*
- *Technical specifications and performance data*
- *Operating instructions*
- *Control systems and interlocks*
- *Operating hazards*
- *Checks and inspections*

2. Operator Safety

McCoy recommends that a hazard assessment of the work area be performed by a designated safety representative before commencing operations. A designated safety representative is responsible for verifying that all operators have adequate equipment and safety training.

The safety door system is the primary device protecting the tong operator and nearby personnel from the rotary gear. Confirm the correct operation of the safety door before every job. Never disable the safety door device.

The area surrounding the tong operating area must be clutter-free and free from tripping hazards, or protruding objects that may snag hydraulic hoses on the tong, backup, lift cylinder, or torque measurement system. Operating surface or drill floor must be kept free of slipping hazards like grease, oil, water, etc.

Adequate lighting of the work area is required. All warnings, labels, gauges, and signs must be clearly visible

The components of the tong commonly manipulated or requiring control input are painted green, and are safe for continuous handling. Areas painted yellow are designated as hazardous areas, and contact with those areas must be avoided during operation. Always wear all personal protective equipment (PPE) specified by your company's HSE policy, and follow all of your company's safety guidelines.

ALWAYS WEAR APPROVED PERSONAL PROTECTIVE EQUIPMENT (PPE) WHEN OPERATING HYDRAULICALLY-POWERED EQUIPMENT.

Ensure hydraulic power is deactivated and tong hydraulics are de-pressurized before disconnecting the main hydraulic lines. McCoy recommends depressurizing the tong hydraulic system before connecting or disconnecting quick-connect fittings.

DEPRESSURIZE EQUIPMENT BEFORE DISCONNECTING MAIN HYDRAULIC LINES.

3. Valve Operation

4-way proportional valves control operation of hydraulic devices on the tong assembly such as hydraulic motors and cylinders. When any one valve is "centered" or in the detent position, there is no hydraulic output from the valve. When the valve is pushed forward there is an effect, and when the valve is pulled back, there is an opposite effect. These valves feature proportional control, which means that further extension of the valve handle (thereby further opening the valve orifice) results in proportionally higher hydraulic output to the controlled device.

The illustrations on the following pages demonstrate the type and effect of the hydraulic valves with which this tong is may be equipped.

3. Valve Operation

4-way proportional valves control operation of hydraulic devices on the tong assembly such as hydraulic motors and cylinders. When any one valve is "centered" or in the detent position, there is no hydraulic output from the valve. When the valve is pushed forward there is an effect, and when the valve is pulled back, there is an opposite effect. These valves feature proportional control, which means that further extension of the valve handle (thereby further opening the valve orifice) results in proportionally higher hydraulic output to the controlled device.

The following illustration demonstrates the type and effect of the hydraulic valves with which this tong is may be equipped.

TONG MOTOR

This is a proportional valve. Pushing the valve handle forward will cause the tong motor to rotate in a clockwise direction (as seen from the top of the tong). This is the desired direction of rotation for making up a joint. Pulling the valve handle in the opposite direction results in counter-clockwise rotation, which is the desired direction of rotation for breaking out a joint.

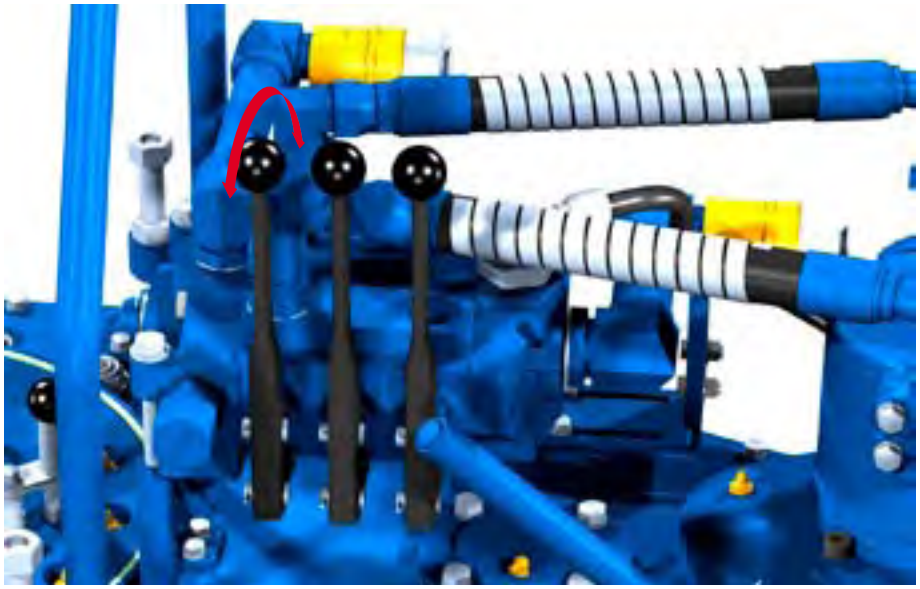

ILLUSTRATION 2.H.1: TONG MOTOR CONTROL VALVE

LIFT CYLINDER

This is a direct-acting valve. Pulling out on the valve handle will cause the lift cylinder to lift the tong vertically. Pushing in on the valve handle will cause the lift cylinder to lower the tong. Releasing the valve handle will immediately stop the lifting or lowering action.

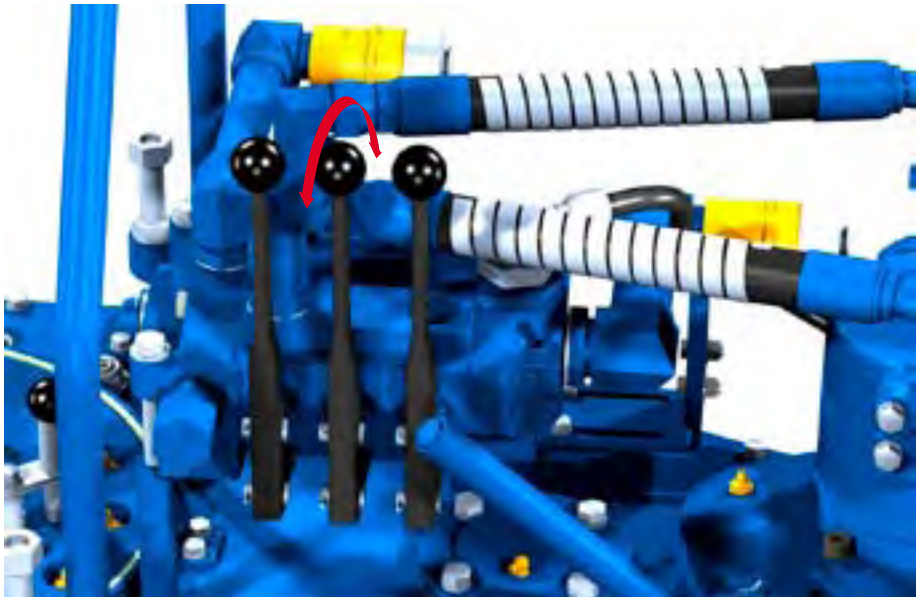

ILLUSTRATION 2.H.2: LIFT CYLINDER CONTROL VALVE

BACKUP

Depending on the type of backup with which your system is equipped (Wedge, Clincher, or Hydraulic) pushing forward on this valve will extend the backup cylinder (s), or actuate a sequence valve. Pulling backward, towards the operator, reverses the action.

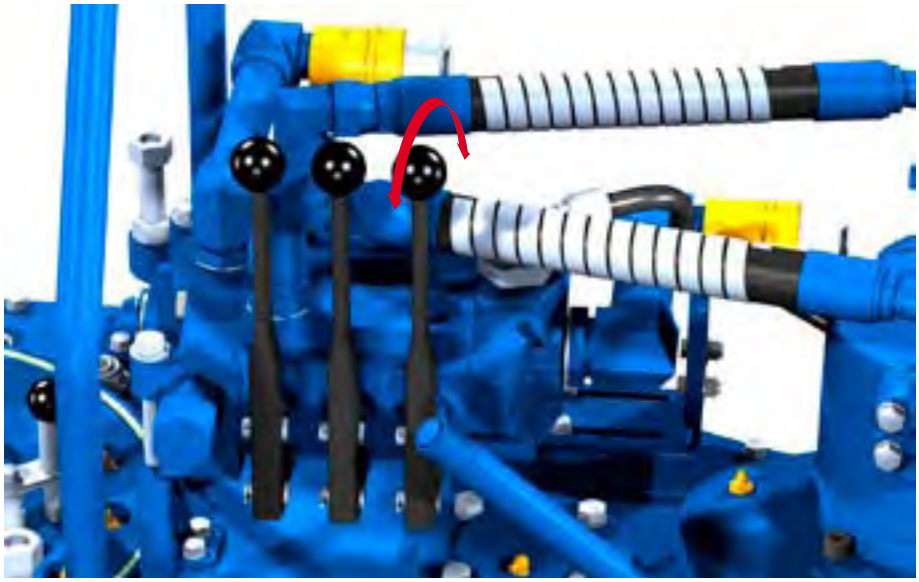

ILLUSTRATION 2.H.3: BACKUP CONTROL VALVE

4. Shifting Gears

The shifting shaft has three "detent" positions identifying the low speed/high torque position, the "neutral" or free-spinning position, and the high speed/low torque position. The detent strength may be adjusted by releasing the locknut on the detent tube and increasing or relaxing pressure on the detent spring. Ensure the locknut is tightened once the desired detent pressure has been set.

To shift to the high-speed gear, move the shifting handle upward from neutral position. To shift to the low-speed gear, move the shifting handle down through the neutral detent to its lowest position. Note that the high clutch gear or the low clutch gear may not be exactly aligned when shifting, so the operator may need to "bump" the motor control handle slightly to turn the main clutch gear shaft and shifting collar into alignment. This is most effective when applying a small amount of pressure on the gear shift lever in the direction you want to shift the tong, ensuring the shifting collar will "catch" when the main clutch gear aligns with either the high or low clutch gear.

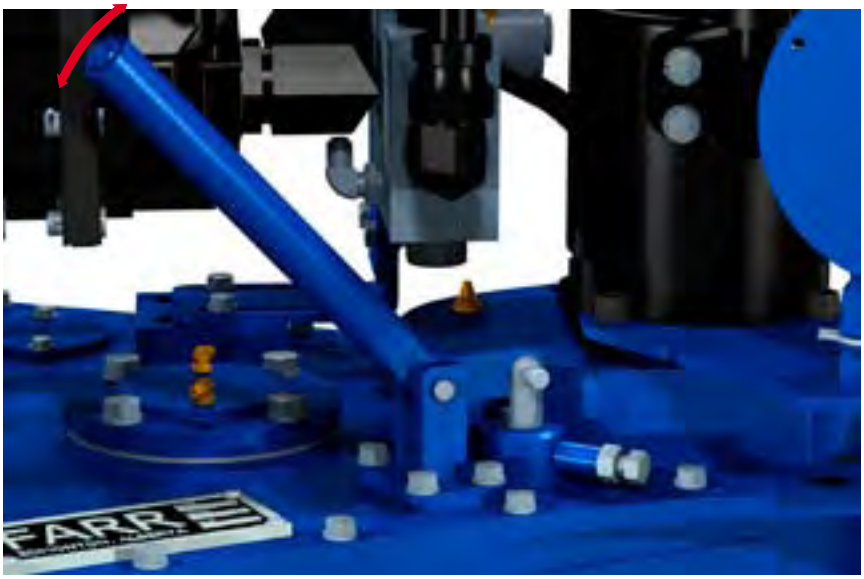

ILLUSTRATION 2.H.4: SHIFTING GEARS

SHIFTING TONG WHILE ROTATING THE MOTOR AND CAGE PLATE MAY RESULT IN CATASTROPHIC GEAR TRAIN FAILURE

5. Pre-Operational Checks

McCoy recommends that the following pre-operating tests be performed prior to releasing the tong assembly to a operational environment:

a. *Connect the tong to a hydraulic power source in a controlled environment. Ensure the power unit's operating parameters are within the specifications as identified on Pg. 1.3. Ensure the hydraulic connections from the power unit are properly and securely made up (see Section 2.E). Do not neglect to connect the motor drain line.*

b. *Start the power unit as specified by the power unit operator's manual. Open the Bypass Valve on the hydraulic system, and inspect all pressure and return line hose connections to ensure correct and secure installation. A restriction in the pressure supply hose will result in high pressure within the power unit hydraulic system, which will activate the hydraulic governor and increase the engine speed to as high as maximum RPM. A restriction in the return line will result in high pressure within the power unit and the tong hydraulic system, causing engine speeds as high as maximum RPM, and possible failure of the motor seal.*

A CLEARLY IDENTIFIED REMOTE POWER PACK EMERGENCY STOP MUST BE INSTALLED IN THE IMMEDIATE VICINITY OF THE TONG OPERATOR.

c. *Allow hydraulic system to warm by circulating fluid for about 10 minutes, then slowly close the bypass valve to allow hydraulic fluid to circulate through the hoses and tong. Ensure circulating pressure does not exceed 200 psi.*

d. *Inspect all hydraulic hoses and connections on the tong. Immediately correct any hydraulic fluid leaks.*

e. *Inspect all gauges. Replace leaking or cracked gauges, or any gauge not registering a reading.*

f. *Confirm that all load-bearing pins and R-clip retainers are installed and in good condition (rigid sling pins, lift cylinder pins).*

g. *Confirm all hydraulic hoses (with the exception of the supply & return to the backup) are securely fastened to the tong, and are not in contact with the cage plate or creating a snagging hazard.*

h. *Ensure the tong door is securely closed before rotating tong.*

DOOR MUST BE CLOSED AND SECURELY LATCHED BEFORE TONG ROTATION IN ORDER TO ASSURE THE SAFETY OF OPERATING PERSONNEL.

i. *Shift the tong to low gear (see Section 2.H.4) and rotate the tong slowly forward for approximately a minute. Stop the tong and then reverse the rotation direction for approximately another minute. Stop the tong, shift to high gear, and operate in high gear for approximately another minute. Stop the tong and rotate in the opposite direction in high gear for approximately another minute. If at any time abnormal operation is suspected (surging, grinding, squealing, or other noises deemed to be unusual, or failure to operate) discontinue operation of the tong and contact McCoy Drilling & Completions immediately.*

j. *Re-inspect all hydraulic lines and connections on the tong, and correct all leaks.*

k. *The safety door system is the prime protective measure separating the operator from the rotary gear, and must be in working condition when operating tong. Carefully inspect the safety door components, and test the operation of the safety door using the following procedure:*

   i. *Keep non-essential personnel clear of the unit under test. This test procedure will only include two people: one to run the control valve and one to operate the door.*

   ii. *Ensure the tong door is securely closed.*

   iii. *Shift to LOW gear.*

   iv. *Begin rotating the tong (direction of rotation is not important).*

   v. *Open the tong door while the rotating the tong. The tong must immediately and completely stop rotating as soon as the door is opened.*

   vi. *Continue to apply rotation control, and open & close the door throughout its complete range. Slowly close the door until it latches. Rotation must not begin until the door is completely closed and securely latched.*

If the safety door does not operate as designed, the safety door switch may require adjustment, or further troubleshooting of the safety door system may be required. See Section 3.F.4 for safety door switch adjustment procedures, and Section 4.D for safety door troubleshooting instructions.

The safety door switch is protected from impact by a sturdy metal guard, painted yellow. This guard must be inspected before each use of the tong. All components of the guard must be in place, and all fasteners securing the guard must be intact and tight.

DO NOT OPERATE TONG WITH A MALFUNCTIONING OR NON-OPERATING SAFETY DOOR SYSTEM.

6. General Operational Comments

a) *Position rotary gear in contact with both idler gears when breaking out joints or collars where high torques are required.*

b) *When making-up integral (shouldered) joints, it is essential to make up the last turn of the threads in low gear. This reduces the tendency of an instant stop or a sudden increase in torque, which induces extremely high stresses on the gear train.*

c) *DO NOT employ the "snap break" method of breaking-out joints when pulling a string. By definition, the "snap break" method is a procedure used by some operators to break out connections, accomplished by leaving slack in the "jaw-pipe" engagement, and then quickly pulling the throttle valve control lever allowing the tong to snap into its loaded or high torque condition. Although this method is very effective in breaking out joints, the extremely high stress placed on the gear train frequently causes gear breakage.*

THE "SNAP-BREAK' METHOD IS HAZARDOUS TO PERSONNEL AND EQUIPMENT

I. EXTREME COLD WEATHER OPERATION PROCEDURES

1) *Consult the power unit engine operator's manual for all cold weather operating procedures and precautions.*

2) *Select gear and bearing lubricants that are compatible with expected climatic conditions.*

3) *Select hydraulic fluid that is compatible with expected climatic conditions.*

4) *Allow hydraulic fluid to circulate for approximately 20 minutes after starting the power unit, prior to activating the bypass valve to allow fluid to circulate to tong. If the power unit is equipped with an oil temperature gauge, ensure that the fluid has reached operating temperature as specified by hydraulic fluid data sheet.*

5) *Allow for adequate drying of moisture (prior to lubricating) when cleaning tong parts in cold weather.*

McCoy Drilling & Completions recognizes that minor on-site repairs and modifications are required to maintain peak operating condition of your equipment, or to match your equipment with the operating environment. Examples of minor repairs are

- *replacement of damaged hydraulic hoses and fittings.*
- *replacement of malfunctioning pressure gauges and valves.*
- *replacement of door cylinders*
- *replacement of fasteners*

Any replaced component must be an identical component supplied by McCoy Drilling & Completions. Replaced fasteners must be Grade 8 or equivalent, or whatever fastener is specified by McCoy Drilling & Completions.

A. GENERAL MAINTENANCE SAFETY PRACTICES

The practices identified here are intended as a guideline. All personnel are responsible for performing their tasks in a manner that ensures worker, equipment, and environmental safety, and may require taking additional steps that are not identified in this section.

Equipment maintenance shall be performed only by designated qualified maintenance personnel. Wear approved eye wear and footwear, and follow all of your company's safety guidelines Do not begin a maintenance task without the proper tools or materials on hand, or the proper drawings and documentation necessary.

Schedule planned maintenance with operators to avoid conflicts, unnecessary downtime, and the danger of accidental equipment activation. Notify operations when maintenance procedures are complete and equipment functionality is restored.

Isolate the location of the maintenance under way to prevent unaware personnel from inadvertently exposing themselves to a hazard. Use tape, rope, or signage to clearly indicate "off-limits" area.

Replacement of large, heavy individual parts and/or heavy structural components must be performed using an approved lifting device of sufficient lifting capacity. Use care when attaching the lifting device, and safeguard area to avoid endangering personnel or equipment.

All spare parts must meet or exceed OEM specifications in order to maintain equipment integrity, especially protective equipment

McCoy Drilling & Completions recommends that disconnection of hydraulic connectors be performed with the power unit off and the hydraulic circuit depressurized.

Your equipment uses materials that may be harmful to the environment if improperly disposed of (hydraulic fluid, grease, etc.). Dispose of all materials according to your company's proscribed environmental protection regulations.

B. CLEANING

Clean tong thoroughly cleaned with a good petroleum-based cleaning agent after each job, prior to storage. Farr recommends that the motor and valve assembly be periodically removed, along with the top tong plate, so that guides, rollers and gears can be properly cleaned. Ensure that cleaning solvents and chemicals are captured to prevent environmental contamination, and dispose of all materials according to your company's proscribed environmental protection regulations.

C. PREVENTIVE MAINTENANCE PRACTICES

Regular maintenance programs are necessary, and must be established to assure safe, dependable operation of your Hydraulic Tubular Connection System and to avoid costly breakdown maintenance. The following maintenance procedures provides information required to properly maintain your equipment. Your equipment may require more, or less maintenance depending upon the frequency of use and the field conditions under which your equipment operates. These maintenance procedures are designed for equipment operating at 10°C to 35°C ambient temperature for 10 hours per day. McCoy Drilling & Completions recommends that the inspection and maintenance procedures in this section be performed as recommended in the maintenance checklists (see Appendices), or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

Purchased components included with your hydraulic tubular connection equipment (for example: motors, valves, etc.) may specify maintenance tasks and intervals over and above what McCoy Drilling & Completions recommends as part of their recommended procedures. Users of this equipment may choose to perform or ignore these additional tasks at their discretion.

Premature fouling of particulate filters within your prime mover or ancillary hydraulic power unit requires immediate hydraulic fluid laboratory analysis to prevent premature wear of hydraulic system due to high levels of wear metals in the fluid.

McCoy Drilling & Completions recommends tracking all maintenance activity including the lubrication schedule. This may be a simple as keeping a paper log, or using a software-based maintenance tracking utility. A maintenance log is a valuable tool that can be used for easily retrieving maintenance history or identifying trends that require correction.

D. LUBRICATION INSTRUCTIONS

Use a quality multipurpose bearing lubricant that will remain within its viscosity range at expected operating temperatures. In addition, Farr recommends the following lubrication procedure at the completion of each job prior to storage.

1. Cage Plate Cam Followers

Apply grease to the grease fittings recessed in both the top and bottom cage plates (26 locations total - 13 top / 13 bottom).

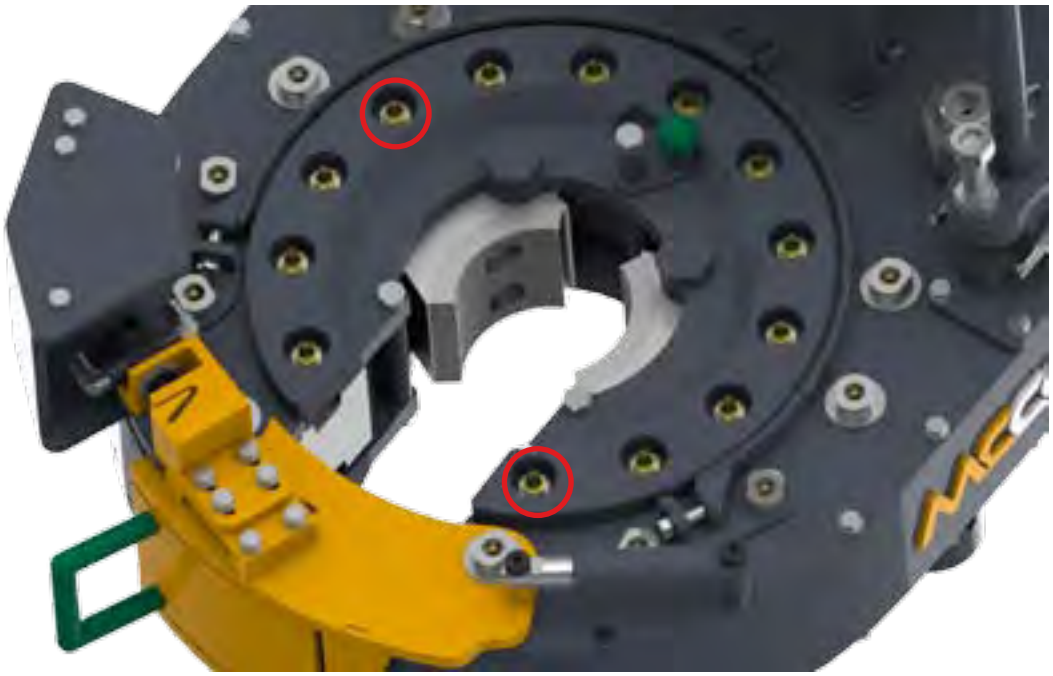

ILLUSTRATION 3.D.1: CAM FOLLOWER LUBRICATON

2. Support Roller Bearings

Apply grease to the support roller bearings through the grease fittings recessed into the top of each support roller shaft. (ten locations total).

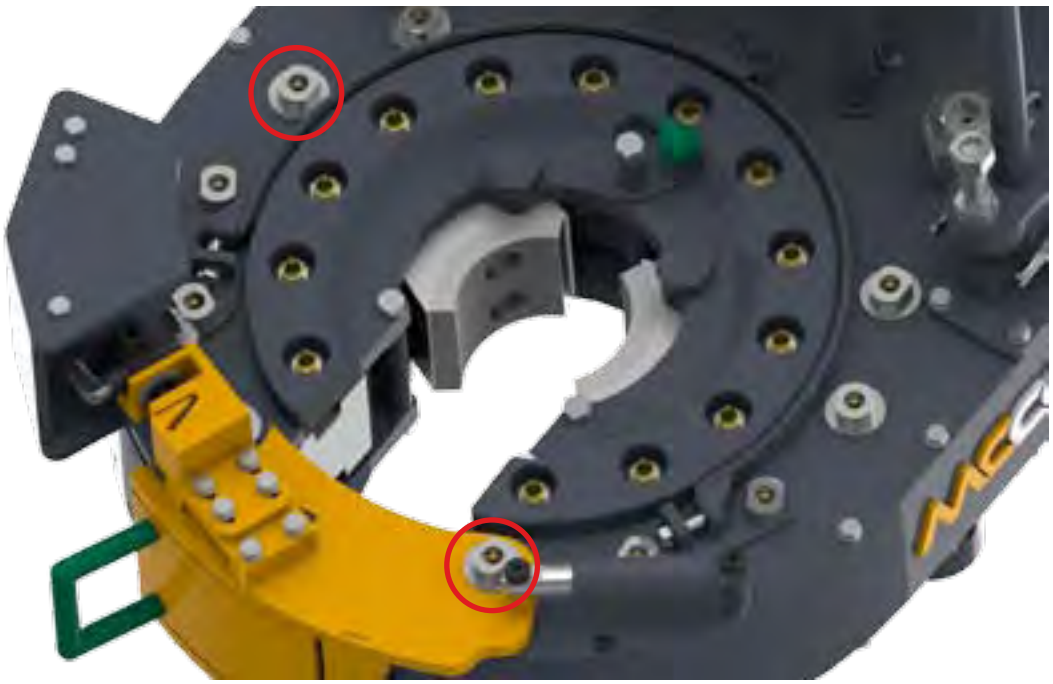

ILLUSTRATION 3.D.2: SUPPORT ROLLER BEARING LUBRICATION

3. Rotary Idler Bearings

Apply grease to the rotary idler bearings through the grease fittings recessed into the top of each shaft on the top face of the tong (two locations total).

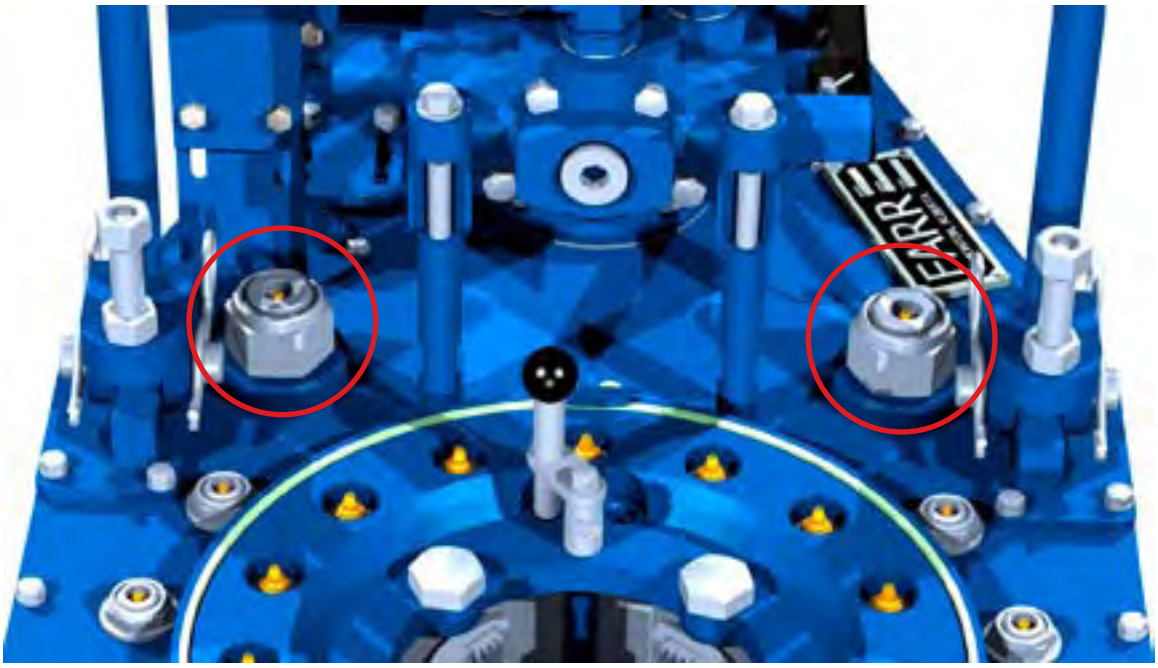

ILLUSTRATION 3.D.3: ROTARY IDLER BEARING LUBRICATION

4. Pinion Idler Bearing Lubrication

Apply grease to the pinion idler bearing through the grease fitting recessed into the top of the half-shaft, located on the bottom face of the tong (one location only).

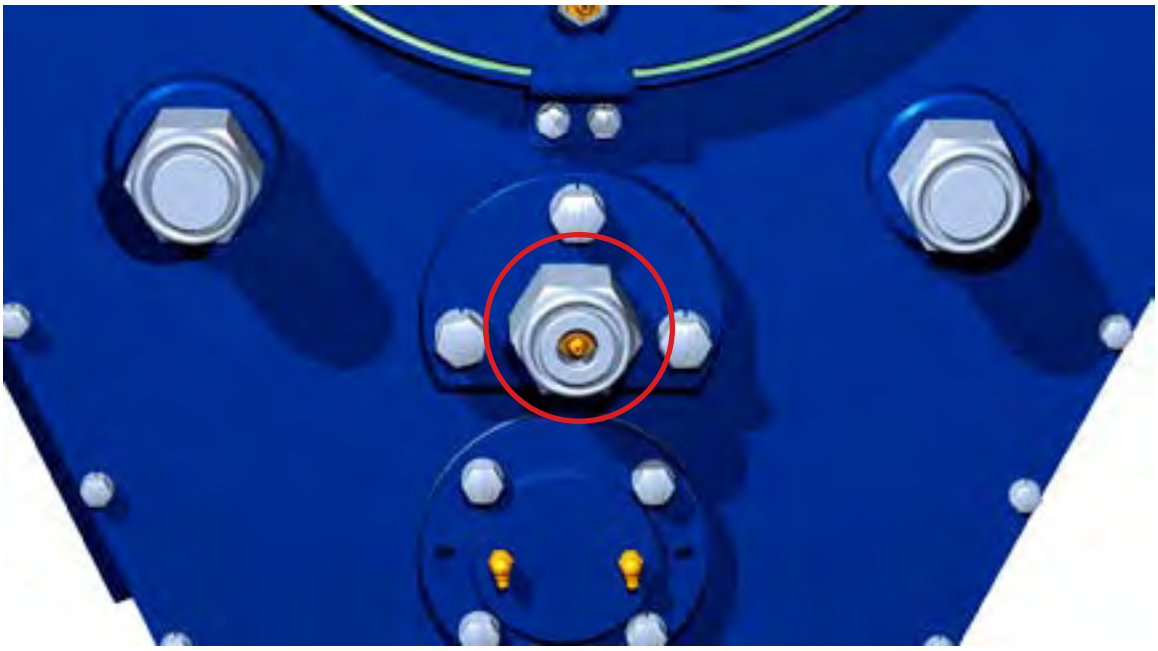

ILLUSTRATION 3.D.4: PINION IDLER BEARING LUBRICATION

5. Pinion

Apply grease to the pinion bearings through the grease fittings located on the bearing caps on the top and bottom faces of the tong (two locations top, two locations bottom).

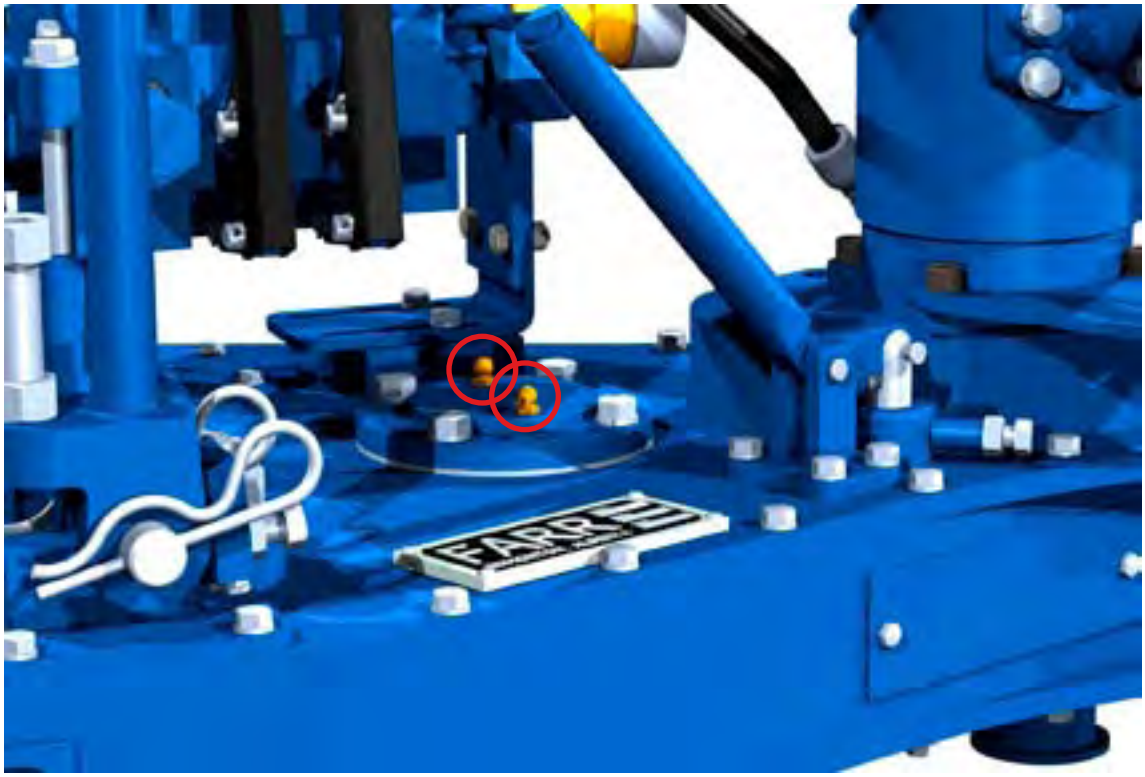

ILLUSTRATION 3.D.5: PINION BEARING LUBRICATION

6. Clutch Bearings

Apply grease to the clutch bearings through the two grease fittings located on the clutch bearing cap on the bottom face of the tong, and the single grease fitting recessed into the end of the clutch shaft. (three locations total).

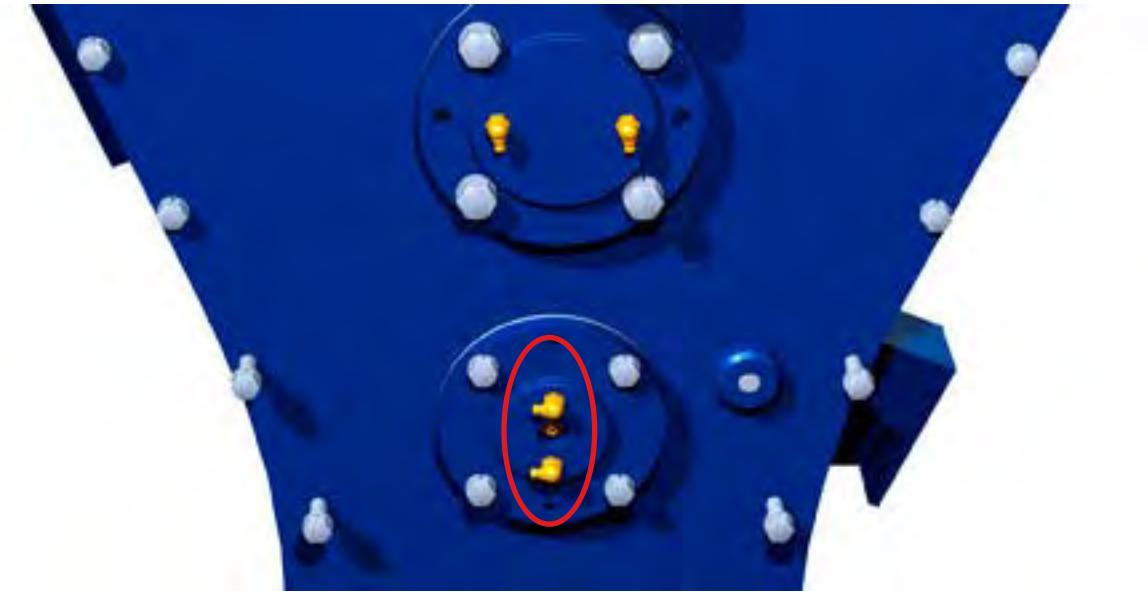

ILLUSTRATION 3.D.6: CLUTCH BEARING LUBRICATION

7. Motor Mount

Apply grease to the motor gear/clutch drive gear through the grease fitting located on the top of the motor mount (one location only).

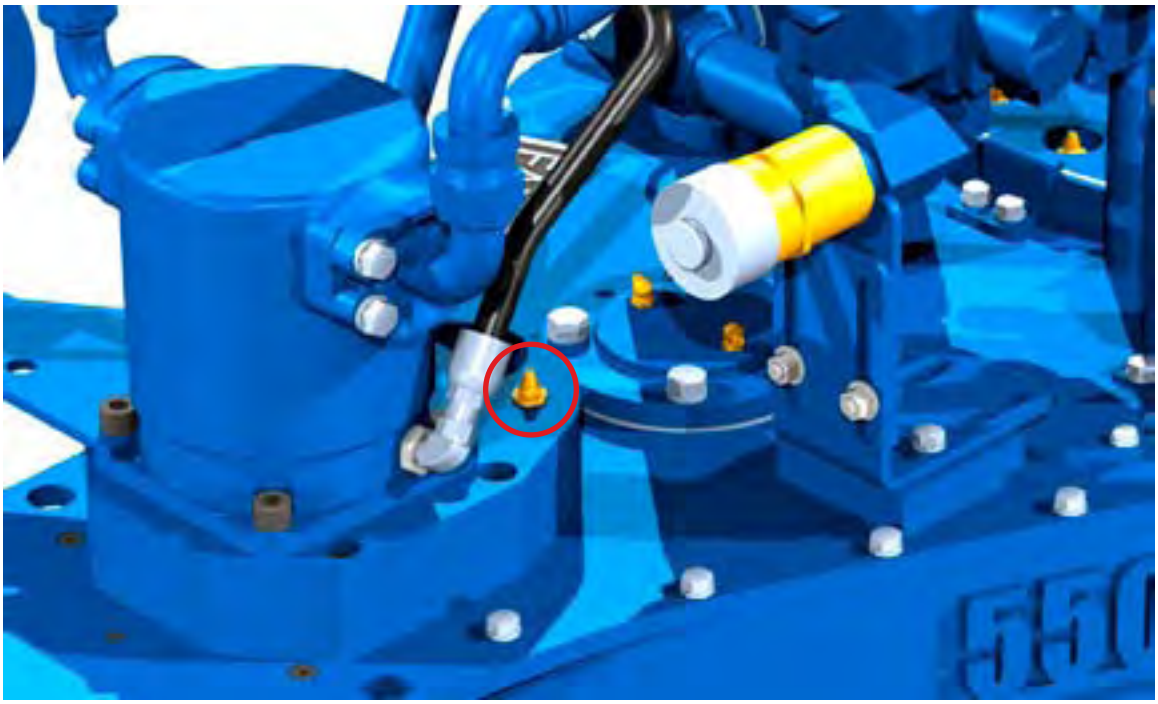

ILLUSTRATION 3.D.7: MOTOR GEAR / CLUTCH DRIVE GEAR LUBRICATION

8. Shifting Shaft

Apply grease to the shifting shaft and top shifting shaft bushing. The shaft and shifting yoke can be accessed through the cover plate on the side of the tong.

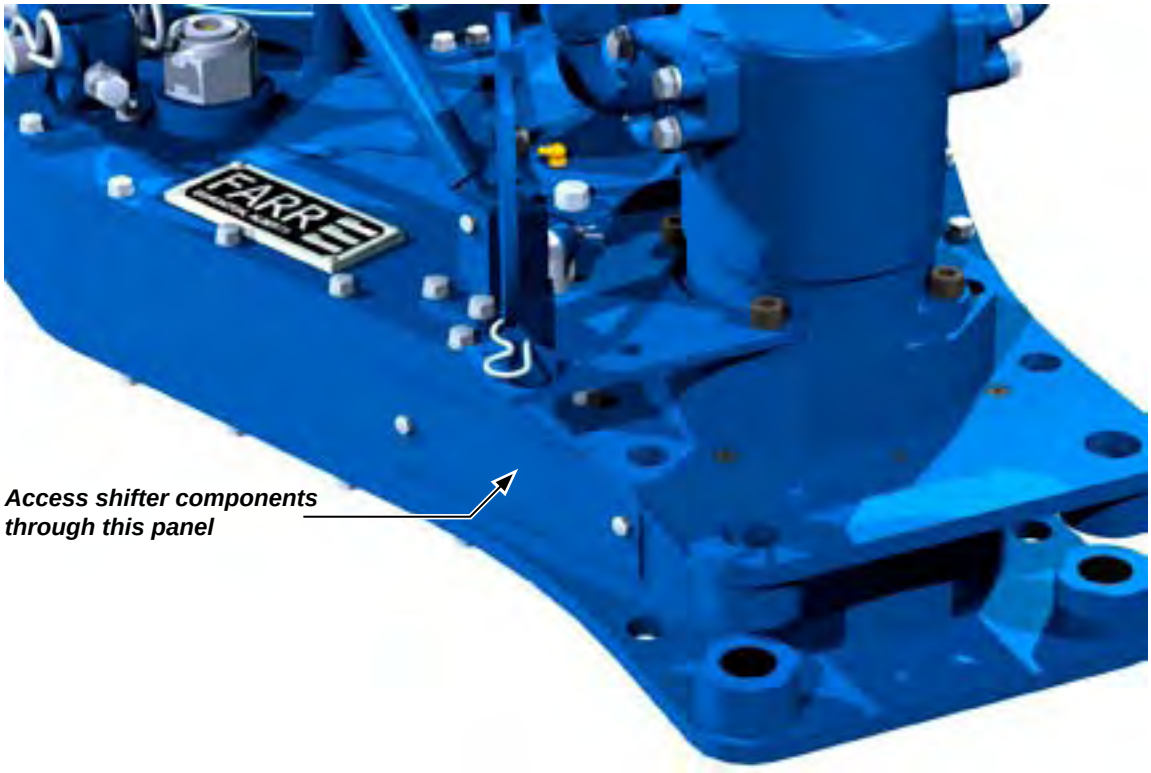

ILLUSTRATION 3.D.8: SHIFTING SHAFT LUBRICATION

9. Door Latch

Apply grease to the door latch through the grease fitting located in the top of the adjustment cam.

ILLUSTRATION 3.D.9: DOOR LATCH CAM SHAFT LUBRICATION

10. CLINCHER® Cylinders

Apply grease to the external surfaces of the clincher cylinders through the grease fittings in the top and bottom body plates (eight locations total).

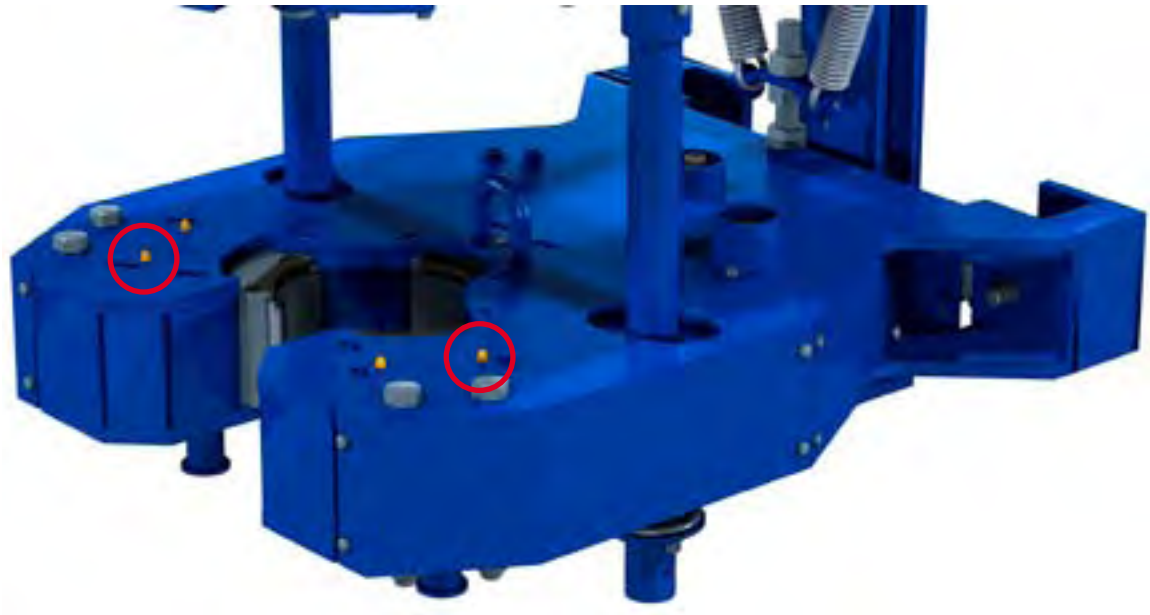

ILLUSTRATION 3.D.10: CLINCHER© CYLINDER LUBRICATON

11. Compression Load Cell (Compression Load Cell Style Backups Only)

Apply grease to the flat surfaces of the compression load cell where contact is made with the rear leg and the paddle of the backup.

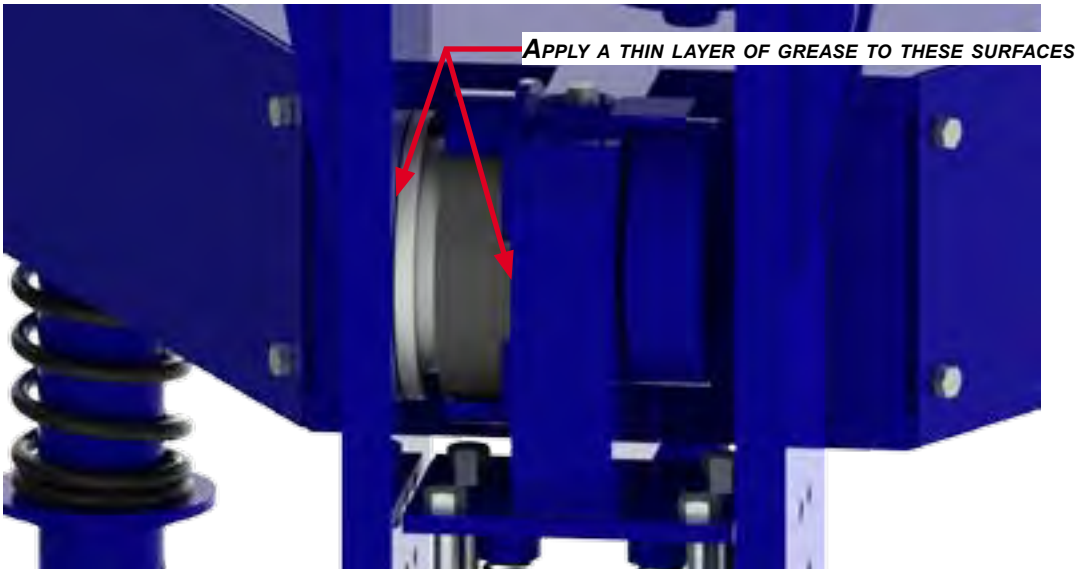

ILLUSTRATION 3.D.11: BACKUP LUBRICATION

Farr recommends that a liberal coating of grease be applied to the cam surface of the rotary drive gear prior to jaw installation. Also, the clutch inspection plate should periodically be removed and a coating of grease applied to the clutch, drive gears and shifting shaft.

E. ADJUSTMENTS

1. Brake Band Tension Adjustment:

The top and bottom brake bands must be periodically adjusted to continue to provide smooth and efficient jaw cam action. If the cage plate turns with the rotary gear, the jaws will not cam properly and, therefore, will not bite on the tubing or casing. Tightening the brake band against the cage plates will increase frictional resistance, allowing jaws to cam properly and grip the casing. Adjust the brake band using the adjustment nut and bolt set as shown in the illustration below. Use caution, as over-tightening will cause excessive wear to the brake bands.

ILLUSTRATION 3.E.1: BRAKE BAND ADJUSTMENT

TOP AND BOTTOM BRAKE BANDS MUST BE ADJUSTED SIMULTANEOUSLY AND EQUALLY

2. Door Latch Adjustment

Normal operation of the tong may cause wear of the door latch, which will cause the door to develop a loose fit at the latch. A latch cam plate is located at the top face of the door. The cam plate has eight positioning holes located on a 360 degree bolt circle. The latch cam shaft extends down through the door and is secured at the top by a 3/8" hex head bolt. To make adjustments in door alignment, remove the 3/8" bolt and turn the cam with a wrench. When the door has been adequately aligned, replace the 3/8" bolt (see illustration 3.E.2).

THE DOOR IS AN IMPORTANT PART OF THE STRUCTURAL INTEGRITY OF THE TONG. IT IS IMPERATIVE TO KEEP A SECURE FIT AT THE DOOR IN ORDER TO MAINTAIN PROPER GEAR ALIGNMENT, AND TO MINIMIZE THE POSSIBILITY OF DAMAGE TO THE GEAR TRAIN WHEN OPERATING THE TONG AT SPECIFIED TORQUE. A CLOSED DOOR ALSO ENSURES SAFETY OF OPERATING PERSONNEL.

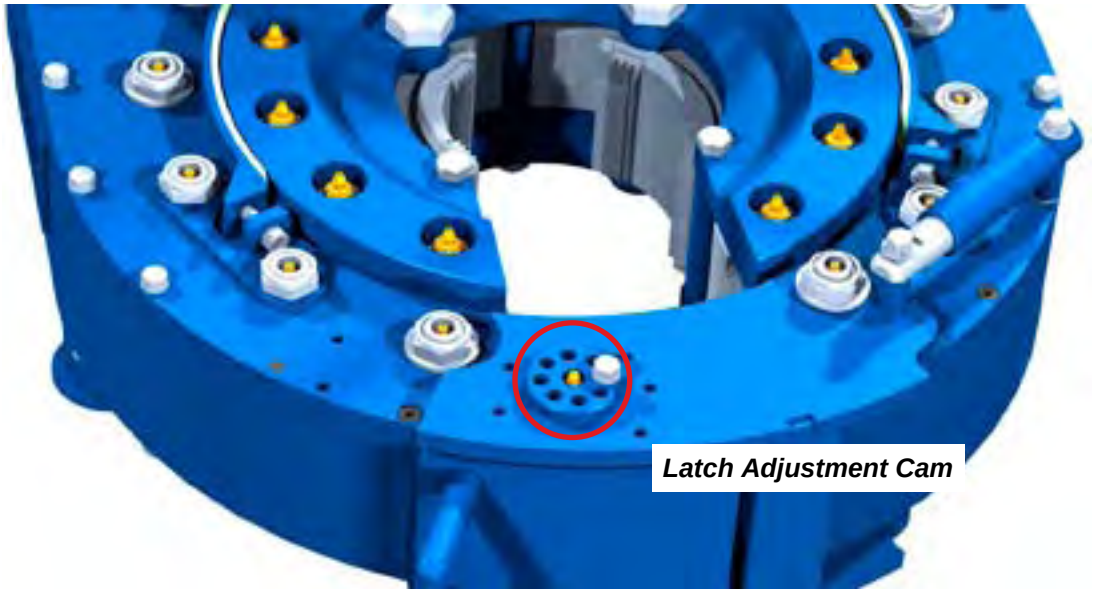

ILLUSTRATION 3.E.2: DOOR LATCH CAM ADJUSTMENT

3. Shifter Detent Force Adjustment:

Over time wear to the shifting shaft, wear to the detent ball, and loss of spring tension in the detent spring may result in a loose or "sloppy" fit within the top shifter bushing. The detent pressure may be increased or otherwise adjusted by loosening the 7/16" UNF locking jam nut, and turning the 7/16" UNF detent bolt. Should adequate detent action not be achieved, the shifting shaft, detent ball, or detent spring (or possibly all three) may need to be replaced (see Pp. 5.16 - 5.17).

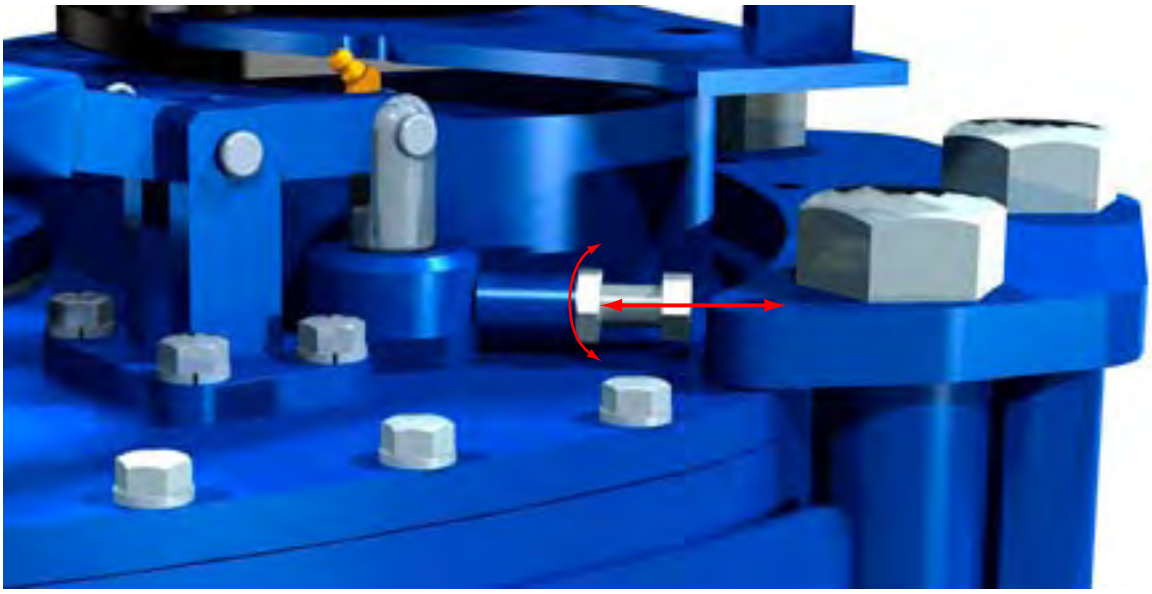

ILLUSTRATION 3.E.3: SHIFTER DETENT FORCE ADJUSTMENT

F. RECOMMENDED PERIODIC CHECKS

1. Door Stop Spring

The spring inside the actuator cylinder must be of sufficient strength to enable the door latch mechanism to snap closed properly, and to hold the door in the open position when opened. Door stop spring fatigue will result in sluggish latch operation. Replace the latch spring inside the cylinder when this occurs.

2. Backing Pin

Perform a visual inspection of the backing pin after each job. Replace the pin if stress cracks or excessive wear is found, or if either pin is bent.

3. Shifting Shaft

The shifting yoke is secured to the shifting shaft by a locknut on the bottom of the yoke. Check locking nuts after each job. Do this by removing the clutch inspection plate and ensuring a snug fit prior to lubrication.

4. Torque Gauge Assembly

Periodic calibration of the torque gauge is recommended to assure accurate torque readings. When having the torque gauge serviced and calibrated, it is critical to note the arm length of the tong, as indicated in the "Specifications" section. Farr recommends that the torque gauge assembly be calibrated yearly. Periodically check to ensure the load cell is filled with oil (see Section 6).

G. OVERHAUL PROCEDURES

The tong may be overhauled following the disassembly instructions in the following procedure. Access to the gear train is possible by removing the top plate of the tong.

ALL MAINTENANCE AND OVERHAUL SHOULD BE PERFORMED FROM THE TOP. THE BOTTOM PLATE OF THE TONG IS TYPICALLY WELDED TO THE SIDE BODY AND CANNOT BE REMOVED.

REPLACEMENT FASTENERS (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT.

FASTENERS USED FOR MAINTENANCE OR OVERHAUL OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, LEGS) MUST BE TIGHTENED TO THE PROPER TORQUE.

SEPARATION OF TONG FROM BACKUP

1. *Suspend tong assembly with crane. Construct a support structure that will support the weight of the backup. Lower the tong/backup assembly onto the constructed support until all weight is removed from front leg suspension springs.*
2. *Disconnect all hydraulic lines from the backup.*
3. *Remove the nylock nut and bolt sets from the bottom of the front legs, and slide the lower spring caps and front leg coil springs off each leg. Note that the top spring caps will remain within the backup body assembly.*
4. *Disconnect the two rear backup support springs connecting the backup to the rear leg (not applicable for low-profile compression-style backup).*
5. *Remove the load cell assembly.*
6. *Lift tong and legs up and away from the backup, and set tong onto a flat work surface that will support the weight of the tong, and allow access to the bottom plate- ensure that the legs do not have any weight on them.*

REMOVAL OF LEG ASSEMBLIES.

7. *Remove the rear leg assembly by removing two 1-1/4" x 8" hex bolt and nut sets and two 7/8" x 9" hex bolt and nut sets.*
8. *Remove the front leg assemblies by removing the 1/2" x 3-3/4" bolts and nut set on each leg, and slide leg tubes out of leg mount weldments.*

REMOVAL OF TOP PLATE

9. *Remove the rigid sling assembly by disconnecting the leveling devices from the hanger brackets.*
10. *Remove the two rigid sling hanger brackets.*
11. *Disconnect the three hydraulic connections from the motor. Undo the restraints securing the inlet and outlet lines from their supports, and lift the hydraulic valve section away from the tong. Remove the inlet and outlet support pieces.*
12. *Remove top brake band assembly (leave adjustment lug weldments in place for now).*
13. *Remove the tong door stop cylinder.*

Removal of Top Plate Continued...

14. *Remove door assembly by removing the door roller shaft. Support door assembly as the roller shaft is removed. Remove the nut from the top of the roller shaft, and use a soft alloy material (e.g. brass rod, etc.) to lightly tap the shaft down through the support roller assembly until it comes free at the bottom. Use caution that the threads on the ends of the support roller shafts are not damaged. Do not lose the door shoulder bushings.*
15. *Remove the hitch pin securing the torque gauge holder to the torque gauge mount weldment, and remove the mount.*
16. *Remove the four hex socket head cap screws securing the motor and the torque gauge mount weldment. Remove the torque gauge mount weldment, then lift the motor up and away from the motor mount. Inspect the motor gear, located at the bottom of the motor shaft, for gear clashing or tooth damage. Also, ensure that the motor gear is securely attached to the motor shaft.*
17. *Remove the cotter pin and clevis pin connecting the shifter handle to the shifter shaft (it is not necessary to disconnect the handle from the pivot lug weldment).*
18. *Unbolt the pivot lug weldment from the top plate, and remove the pivot lug and handle assembly.*
19. *Remove the four hex socket head cap screws securing the motor mount to the top plate. Use care not to dislodge and lose the two positioning dowels.*
20. *Remove the snap ring securing the drive gear to the top of the clutch shaft. Carefully remove the drive gear from the clutch shaft.*
21. *Remove the two 10-24 x 3/4" hex socket head cap screws securing the top clutch bearing retainer to the top plate.*
22. *Remove the top clutch bearing retainer, and bearing retainer spacer. The top clutch bearing and clutch bearing bushing may come off with the bearing retainer.*
23. *Pull the top bearing cap and spacer for the pinion drive gear by removing the four 1/2" bolts which secure the bearing cap. Thread two of the removed bolts into the extra holes on top of the bearing cap, and use them as lifting lugs to lift the bearing cap out of place.*

IF THE BEARING REMAINS ATTACHED TO THE GEAR SHAFT AFTER THE BEARING CAP IS PULLED, MCCOY DRILLING & COMPLETIONS SERVICE PERSONNEL RECOMMENDS LEAVING IT IN PLACE UNTIL THE TOP TONG PLATE IS REMOVED.

16. *Remove the jaw pivot bolts and the jaw assemblies.*
17. *Ensure the bottom cage plate is supported before beginning this step. Remove the two front cage plate bolt and nut sets. Remove the backing pin assembly and the rear cage plate bolt, and the cage plate spacers. The top and bottom cageplates may now be removed - Note that the cam followers are fastened to the top and bottom cage plates, so use caution not to damage them.*

THE CAGE PLATE BOLTS ARE THE ONLY ITEMS FASTENING THE BOTTOM CAGE PLATE TO THE TONG. SUPPORT THE BOTTOM CAGE PLATE FROM BELOW PRIOR TO REMOVING CAGE PLATE BOLTS IN ORDER TO PREVENT DAMAGE TO THE BOTTOM CAGE PLATE OR PERSONAL INJURY TO THE MECHANIC

18. *Remove the top nuts and pads for the rotary idler gears.*
19. *Remove the remaining top roller shaft nuts. Note that the top brake band adjustment lug weldments are removed at this point.*
20. *Loosen, but do not remove the detent bolt on the top shifter lug weldment. Once the force from the detent ball has been removed from the shifter shaft, the top shifter bushing can be un-threaded from the top plate. Take care not to lose the detent ball when the bushing comes free of the shaft.*
21. *Remove the hex head bolts and hex flat head cap screws around the perimeter of the tong that secure the top plate.*
22. *With all the above steps taken, the top tong plate can be lifted off providing access to the inside of the gear case.*

LIFT THE TOP PLATE STRAIGHT UP TO AVOID SNAPPING THE DOWEL PINS. A SNAPPED, BENT, OR OTHERWISE DAMAGED DOWEL PIN CAN BE EXTREMELY DIFFICULT TO REMOVE.

H. ASSEMBLY PROCEDURES

Assembly of Farr Hydraulic Power Tongs is simple, and can be accomplished without the use of special tools. The instructions on this page are presented as a guide only, and are similar to the assembly sequence our technician would use while assembling the tong in our plant.

NOTE ON INSTALLATION PRACTICES: Ensure all bearings are liberally greased before installing over a shaft or into gears or bearing caps. When inserting a shaft through a support roller assembly ensure shaft is greased. Also ensure all metal-to-metal contact in the gear train is adequately greased. When graphics are not used in the assembly process, please refer to the relevant exploded diagrams in Section 5.

ALL FASTENERS USED DURING REASSEMBLY OF LOAD-BEARING COMPONENTS (CHAIN SLINGS, RIGID SLINGS, BACKUP LEGS) MUST BE TIGHTENED TO THE CORRECT TORQUE. THREADED FASTENERS USED IN LOAD-BEARING DEVICES MUST BE SECURED WITH RED LOC-TITE™.

TIGHTENING TORQUE GUIDE			
SAE GRADE 8 - FINE THREAD			
SIZE	**CLAMP LOAD**	**PLAIN**	**PLATED**
1/4 - 28 (.250)	3,263	14 ft. lbs.	10 ft. lbs.
5/16- 24 (.3125)	5,113	27 ft. lbs.	20 ft. lbs.
3/8 - 24 (.375)	7,875	49 ft. lbs.	37 ft. lbs.
7/16 - 20 (.4375)	10,650	78 ft. lbs.	58 ft. lbs.
1/2 - 20 (.500)	14,400	120 ft. lbs.	90 ft. lbs.
9/16 - 18 (.5625)	18,300	172 ft. lbs.	129 ft. lbs.
5/8" - 18 (.625)	23,025	240 ft. lbs.	180 ft. lbs.
3/4 - 16 (.750)	33,600	420 ft. lbs.	315 ft. lbs.
7/8" - 14 (.875)	45,825	668 ft. lbs.	501 ft. lbs.
1 - 12 (1.000)	59,700	995 ft. lbs.	746 ft. lbs.
1 - 14 (1.000)	61,125	1019 ft. lbs.	764 ft. lbs.
1 1/8 - 12 (1.125)	77,025	1444 ft. lbs.	1083 ft. lbs.
1 1/4 - 12 (1.125)	96,600	2012 ft. lbs.	1509 ft. lbs.
1 3/8 - 12 (1.375)	118,350	2712 ft. lbs.	2034 ft. lbs.
1 1/2 - 12 (1.500)	142,275	3557 ft. lbs.	2668 ft. lbs.
SAE GRADE 8 - COARSE THREAD			
SIZE	CLAMP LOAD	PLAIN	PLATED
1/4 - 20 (.250)	2,850	12 ft. lbs.	9 ft. lbs.
5/16- 18 (.3125)	4,725	25 ft. lbs.	18 ft. lbs.
3/8 - 16 (.375)	6,975	44 ft. lbs.	33 ft. lbs.
7/16 - 14 (.4375)	9,600	70 ft. lbs.	52 ft. lbs.
1/2 - 13 (.500)	12,750	106 ft. lbs.	80 ft. lbs.
9/16 - 12 (.5625)	16,350	153 ft. lbs.	115 ft. lbs.
5/8" - 11 (.625)	20,325	212 ft. lbs.	159 ft. lbs.
3/4 - 10 (.750)	30,075	376 ft. lbs.	282 ft. lbs.
7/8" - 9 (.875)	41,550	606 ft. lbs.	454 ft. lbs.
1 - 8 (1.000)	54,525	909 ft. lbs.	682 ft. lbs.
1 1/8 - 7 (1.125)	68,700	1288 ft. lbs.	966 ft. lbs.
1 1/4 - 7 (1.125)	87,225	1817 ft. lbs.	1363 ft. lbs.
1 3/8 - 6 (1.375)	103,950	2382 ft. lbs.	1787 ft. lbs.
1 1/2 - 6 (1.500)	126,450	3161 ft. lbs.	2371 ft. lbs.

REPLACEMENT FASTENER (BOLTS, NUTS, CAP SCREWS, MACHINE SCREWS, ETC.) USED DURING MAINTENANCE OR OVERHAUL MUST BE GRADE 8 OR EQUIVALENT UNLESS OTHERWISE SPECIFIED.

1. *Position the tong body gear case on a suitable stationary support such that the bottom body plate is accessible.*
2. *Assemble ten support roller "dumbbell" assemblies:*
   - *Insert an inner support roller spacer (PN 1064-183) into each dumbbell support roller (PN 1064-181).*
   - *Press a support roller bearing (PN 02-0099) into each end of the dumbbell rollers.*
   - *Slide a support roller bearing spacer (PN 1064-182) over each support roller shaft (5 x PN 101-3942, 4 x PN 101-3944, 1 x PN 101-3943).*
   - *Insert a support roller shaft through completely through each dumbbell assembly.*
3. *Place four support roller assemblies along one side of the cage plate opening.*

ILLUSTRATION 3.H.1: TONG ASSEMBLY - INITIAL SUPPORT ROLLER INSTALLATION

4. *Install rotary gear (PN 1064-D1), making sure the backing pin slots are on the side facing up. Ensure one side is supported by the support rollers installed in Step 3, and the opening in the rotary gear is oriented toward an open support roller space as shown in the following illustration.*

ILLUSTRATION 3.H.2: TONG ASSEMBLY - ROTARY GEAR INSTALLATION

Mechanical Assembly Procedure (Continued):

5. *Install support roller assemblies in the locations exposed by the opening in the rotary gear. Continue to rotate the rotary gear, installing support roller assemblies in the rotary gear opening as it is rotated. Finish with the rotary gear aligned with the opening in the bottom plate.*
6. *Press pinion bearing (PN 02-0007) into bottom pinion bearing cap (PN 997-D15-89), and install bearing cap into bottom plate of tong using four 1/2" UNC x 1-1/4" hex cap screws and four 1/2" lock washers.* ***ASSEMBLY NOTE:*** *Do not neglect to install the clutch bearing cap spacer (PN 1400-89A) between the bearing cap and the bottom plate of the tong.*
7. *Press bottom clutch bearing (PN 02-0004) into clutch bearing cap (PN 997-D11-54), and install bearing cap into bottom plate of tong using four 3/8" UNC x 1-1/4" hex cap screwsand four lock washers.* ***ASSEMBLY NOTE:*** *Do not neglect to install the clutch bearing cap spacer (PN 1400-54A) between the bearing cap and the bottom plate of the tong.*
8. *Install a retainer clip (PN 02-0009) into all three idler gears (PN 997-A2-119). Press an idler bearing (PN 02-0011) into each gear and secure with a second retainer clip.*
9. *Lightly grease the larger circumference of the two rotary idler shafts (PN 997-D19-117) and slide them through two bearing and gear assemblies, centering the gear on the shaft.*
10. *Slide two bearing seals (PN 02-0010) over each end of the idler shafts and press against the retainer clips. See the exploded view of the rotary idler assembly on pp. 5.8 - 5.9 for correct orientation of the bearing seals.*
11. *Slide a bearing spacer (PN 997-D20-121) over each end of the rotary idler shafts.*
12. *Place each rotary idler assembly through the bottom plate, ensuring the ends of the shafts with the threaded holes for the grease fittings are pointed upward.*
13. *Place an idler pad (PN 1400-125) over the bottom side of each rotary idler shaft, and secure each with a 1-1/2" UNF nylock nut.*
14. *Place high pinion gear (PN 997-A4-87) shoulder side down over the lower bearing and bearing cap, centering as best as able.*
15. *Install pinion gear shaft (PN 997-A7-86) into the spline of the bottom pinion gear, and the lower pinion bearing.*
16. *Slide 4 needle bearings (PN 02-0003) onto clutch shaft (PN 997-A8-50), two on either side of the center gear. Press bearings firmly against centre gear.*
17. *Slide high clutch gear (PN 997-A1-51) over the bottom end of the clutch shaft, and seat gear on the needle bearings, ensuring the smaller diameter on the high clutch gear is oriented toward the center gear on the clutch shaft. Place lower end of clutch shaft into the lower clutch bearing that has been pre-mounted in the lower body plate, and mesh the high clutch gear with the high pinion gear.*
18. *Install shifting collar (PN 997-A9-62) over the top of the clutch shaft and mesh with the center clutch gear.*
19. *Slide the shifting fork (PN 997-D13-72) over the end of the shifting shaft (PN 1400-71), and secure the fork in place with a 5/8" UNF hex jam nut followed by a 5/8" UNF regular hex nut. Place the end of the shifting shaft in the lower shifter bushing (typically welded to the bottom plate) and mesh the shifting fork with the shifting collar.*
20. *Slip the low clutch gear (PN 997-A1-52) over the top of the clutch shaft and seat on remaining two needle bearings, ensuring the smaller diameter on the high clutch gear is oriented toward the center gear on the clutch shaft.*
21. *Slide the pinion idler half-shaft (PN 997-D17-105) through the remaining idler gear assembly. Place a bearing seal over the end of the half-shaft, and secure the gear assembly to the half-shaft with a retainer ring (PN 02-0008).*
22. *Place the end of the pinion idler half-shaft through the bottom plate and mesh the pinion idler gear with the two rotary idler gears. Secure the half-shaft to the bottom plate with the half-moon idler pad (PN 1400-109), three 5/8" UNC x 2-1/4" hex bolts and 5/8" lock washers, and a 1-1/2" UNF hex nylock nut.*
23. *Install the low pinion gear (PN 997-A5-88) shoulder side up over the top of the pinion gear shaft, meshing with the low clutch gear.*
24. *Carefully remove all support roller shafts, using caution not to shift the position of the installed support roller assemblies or to damage the threads on the end of the shafts.*
25. *Locate the three un-threaded holes in the side body of the tong, one in the rear centre and one just to either side of the front opening. If old dowel pins are in place, remove them before installation of the top plate. If the dowel pins are in any way damaged or deformed McCoy recommends replacing them with new 3/8" x 1-1/4" hardened dowel pins. If necessary clean the dowel pin holes, and do not insert dowel pins until after the top plate has been installed.*
26. *Use a temporary lifting sling and crane to maneuver the top plate (PN 1400-7T) into position, and place on to the side body. Insert the three positioning dowel pins (PN 09-0021) through the top plate into their respective holes in the side body. Use a hammer to tap the dowel pins until they are flush with the top plate.*

Mechanical Assembly Procedure (Continued):

27. *Secure the top plate with fourteen 3/8" UNC x 1-1/2" hex bolts and 3/8" lock washers, and five 3/8" UNC x 1" low-head height hex socket head cap screws. Do not install fasteners coincidental with the rigid sling brackets (shown circled in green) or the door cylinder post (shown circled in red).*

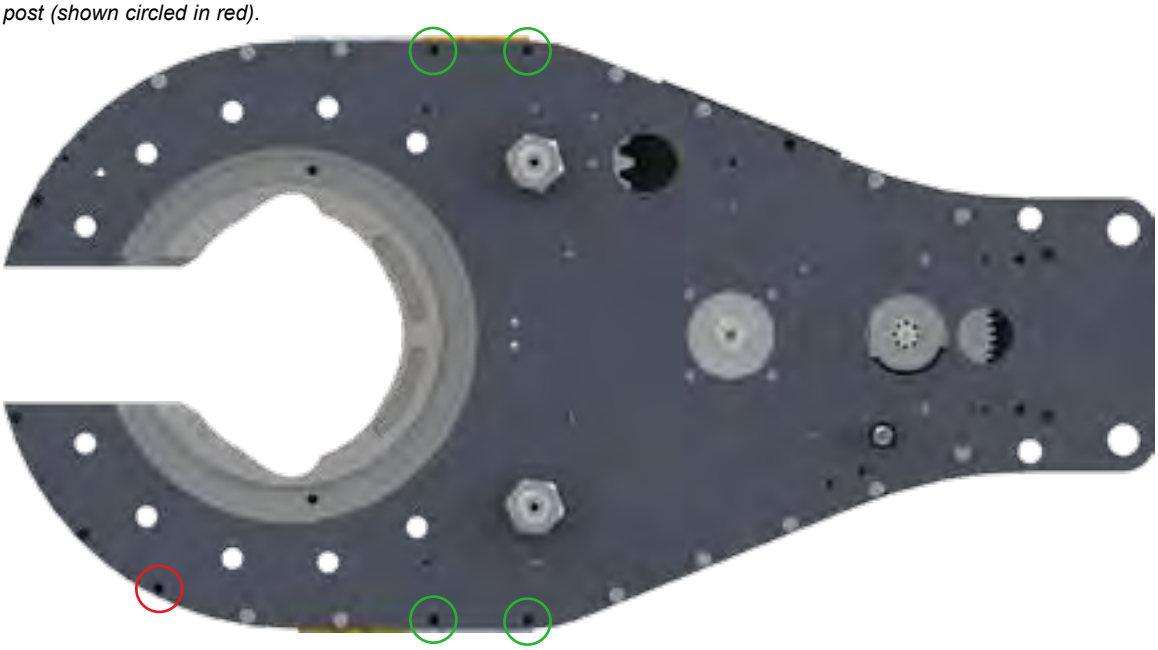

ILLUSTRATION 3.H.3: TONG ASSEMBLY - TOP PLATE FASTENER INSTALLATION

28. *Slide the clutch bearing retainer spacer (PN 1400-59A) over the bottom of the top clutch bearing retainer (PN 997-D11-59), and mount top clutch bearing retainer and spacer to the top plate with two #10-24 x 3/4" hex socket head cap screws.*
29. *Press top clutch bearing (PN 02-0002) into top clutch bearing retainer. Insert clutch bearing bushing (PN 997-60) shoulder side up between bearing and clutch shaft.*
30. *Secure clutch drive gear (PN 997-A3-61) to the top of the clutch shaft with retaining snap ring (PN 02-0001).*
31. *Install rotary idler pads (PN 997-D20-125) over the top of the rotary idler shafts and secure with 1-1/2" UNF hex nylock nuts.*
32. *Press remaining pinion bearing into the top pinion bearing cap (PN 997-D15-89) and secure over the top of the pinion gear shaft with four 1/2" UNC x 1-1/4" hex bolts and 1/2" lock washers.*
33. *Slide the top shifter bushing (PN 101-0020) over the shifting shaft and thread in to the top plate until snug.*
34. *Thread the detent tube (PN 101-0019) into the top shifter bushing as shown. Thread three 5/8" NC x 5/8" hex socket set screws into the remaining three ports in the top shifter bushing - do not bottom out the set screws on the shifting shaft, or the shaft will not move.*

ILLUSTRATION 3.H.4: TONG ASSEMBLY - TOP SHIFTER BUSHING INSTALLATION

Mechanical Assembly Procedure (Continued):

35. *Insert the detent ball (PN 02-0018) through the end of the detent tube attached to the top shifter bushing, followed by the detent spring (PN 997-0-64) Thread a 7/16" UNF jam nut on to a 7/16" UNF x 1-1/4" hex bolt, and then thread the end of the bolt into the detent tube on the top shifter bushing.*
36. *Insert two 5/16" x 3/4" production ground dowel pins into the top plate, one on either side of the motor shaft and gear cut-out, directly behind the clutch assembly.*
37. *Position the motor mount (PN 1400-150) over the dowel pins and secure to the top plate using four 1/2" UNC x 2" hex socket head cap screws.*
38. *Insert a 5/16" x 5/16" x 1-1/2" square key into the key slot on the motor shaft. Secure the motor gear (PN 997-A10-149) to the hydraulic motor shaft using two 3/8" UNC x 3/8" flat point hex socket set screws. Ensure that the motor gear is oriented so that the machined end of the motor gear (the end in which the set screws are threaded) is flush with the end of the motor shaft.*
39. *Mount hydraulic motor (PN 87-0110) to motor mount. Secure the RH side of the motor (as seen from the back of the tong) with two 1/2" UNC x 1-1/4" hex socket head cap screws and 1/2" lock washers. The torque gauge holder weldment (PN 1500-09-04A) is secured by the two LH motor screws - position the torque gauge holder weldment in place, and secure it and the LH side of the motor with two 1/2" UNC x 1-1/2" hex socket head cap screws and 1/2" lock washers.*
40. *Attach the two #20 (1-1/4") x JIC 1" flange elbows (PN 02-9216) to the motor ports using two #20 split flange kits (PN 02-9217).*
41. *Attach the shifter lug weldment (PN 101-0016) to the top plate of the tong next to the top shifter bushing weldment using four 3/8" UNC x 1-1/4" hex bolts and 3/8" lock washers.*
42. *Connect the shifter handle weldment's (PN 1037-D-20B) pivot point to the pivot point of the shifter lug weldment using a 5/16" x 1-1/2" clevis pin. Connect the end of the shifter handle weldment to the top of the shifter shaft using a 5/16" x 1" clevis pin. Secure the clevis pins with .093" X 1.125" hitch pins.*
43. *Position the two top brake band lug weldments (RH Lug Weldment = PN 101-0132, LH Lug Weldment = PN 101-0134) on the top plate over the holes for the support roller shafts as shown in the following illustration. Insert four "short" support roller shafts (PN 101-3942) through the weldments and support roller components until the shoulders of the shafts are tight to the lug weldments. Slide the two bottom brake band lug weldments (LH Lug Weldment = PN 101-0132, RH Lug Weldment = PN 101-0134) over the bottom of the support roller shafts and secure with 7/8" UNF thin nylock nuts.* ***ASSEMBLY NOTE:*** *The support roller assemblies coincidental with the brake band lug weldments DO NOT use flat washers.*

ILLUSTRATION 3.H.5: TONG ASSEMBLY - BRAKE BAND WELDMENT INSTALLATION

Mechanical Assembly Procedure (Continued):

44. *Install the remaining support roller shafts (excluding the door pivot roller shaft):*

    "Stand-Alone" Tongs (Models 80-0420-5, 80-0420-12)

    i. *Slide a 7/8" narrow flat washer over the remaining five support roller shafts (PN 101-3942) and insert into the remaining support roller assemblies (excluding the door pivot support roller).*

    ii. *Secure the bottoms of the support roller shafts with 7/8" narrow flat washers and 7/8" UNF thin nylock nuts with the exception of the two shafts directly behind the brake band lug weldments. These two shafts will serve as leg mounts in a future step.*

    "Backup-Ready" Tongs (Models 80-0420-3, 80-0420-9, 80-0420-14, 80-0420-15)

    i. *Slide a 7/8" narrow flat washer over the remaining "short" support roller shaft (PN 101-3942) and four "long" support roller shafts (PN 101-3944). Insert the short shaft into the support roller assembly directly in front of the RH brake band lug weldment, and insert the four "long" shafts into the four remaining support roller assemblies (two per side directly behind each brake band lug weldment).*

    ii. *Secure the bottoms of the short support roller shaft directly in front of the RH brake band lug weldment with a 7/8" narrow flat washer and 7/8" UNF thin nylock nut. Do not place fasteners on the four long shafts at this time.*

45. *Install thirteen cam followers (PN 02-0016) into the bottom cage plate (PN 1400-22) Secure each with a 5/8" UNF nylock jam nut.*

46. *Install thirteen cam followers (PN 02-0016) into the top cage plate (PN 1400-21) Secure each with a 5/8" UNF nylock jam nut.*

47. *Support the bottom cage plate in position beneath the rotary gear, ensuring the cam followers are nested within the groove in the rotary gear. Place the top cage plate in position over the rotary gear, ensuring the cam followers are nested within the groove in the rotary gear*

48. *Place cage plate spacers (PN 1064-38) between the two cage plates at their connection points, one in the rear centre, and one each side just inside the rotary gear.*

49. *Slide a 1/2" narrow flat washer followed by the backing pin spacer (PN 101-4093) over a 1/2" UNC x 8" hex bolt. Slide the larger diameter hole in the backing pin retainer (PN 101-4095) over the backing pin spacer.*

50. *Attach the bottom cage plate to the top cage plate. Use two 1/2" NC x 6" hex bolts at the front, and the 1/2" x 8" bolt and spacer assembly in the rear ensuring the backing pin spacer remains between the head of the bolt and the top of the top cage plate.*

51. *Thread the 3/8 UNC x 1-1/2" threaded stud (PN 101-4097) into the backing pin (PN 101-4042).*

52. *Insert the backing pin and stud through the bottom of the backing pin retainer installed in Step 49. Slide the short backing pin spacer (PN 101-4096) over the top of the stud, and thread the backing pin knob (PN 02-0017) on to the top of the threaded stud. Lift the backing pin and insert into one of the two receptacles in the rear of the top cage plate.*

53. *Install the top and bottom lined brake band lug weldments (1064-D4-29). Secure the brake bands to the top and bottom plates using one brake band retainer (PN 101-0140) and two 3/8" UNC x 3/4" hex bolts and 3/8" lock washers at the rear of each brake band, and a 3/8" UNF x 2" hex bolt and 3/8" UNF hex nylock nut at each brake band lug weldment.*

54. *Install the tong legs. Secure the front leg mount mount weldments to the bottom of the tong over the exposed support roller shafts using 7/8" UNF thin nylock nuts. See the drawings and BOM on Pp. 5.32 - 5.33 to determine the correct leg mount weldments for your application*

ILLUSTRATION 3.H.6: TONG ASSEMBLY - FRONT LEG MOUNT WELDMENT INSTALLATION

Mechanical Assembly Procedure (Continued):

55. *Attach the door latch weldment (PN 1064-C7-15) to the door weldment (PN 1400-10) using the door latch cam (PN 1400-14) - ensure that the door latch springs (PN 997-16) are installed between the door latch and the door weldment. Thread the door latch cam into the door weldment until in bottoms out, and then back it off until the first adjustment hole in the latch cam aligns with the threaded hole on the top of the door weldment. Secure the latch cam to the door weldment with a 3/8" UNC x 1" hex bolt and 3/8" lock washer.*
56. *Insert the the door pivot shoulder bushings (top bushing = PN 101-5110, bottom bushing = PN 101-5111) in the door weldment - note that the bushings are installed from the insides of the door plates.*
57. *Align the door pivot holes with the pivot holes in the top and bottom plates and insert the door pivot roller shaft (PN 101-3943) - it may have to be tapped lightly with a soft metal or rubber hammer. Use caution when sliding the shaft through the support roller components. Once the shaft has been tapped all the way through, secure the bottom of the shaft with a 7/8 UNF thin nylock nut and 7/8" narrow flat washer.*
58. *If your tong is equipped with the safety door option, it may now be installed (See Pp. 7.32 - 7.33) using the following procedure:*
    - i. *Attach safety door latch block, PN 101-1103, to safety door latch plate, PN 101-1105, using three 3/8" NC x 7/8" flat head countersunk cap screws.*
    - ii. *Place safety door latch plate, PN 101-1105 onto the bottom plate of the safety door guard weldment, PN 101-1481, and align the bolt holes. Secure to the top plate using three 3/8" NC x 2-1/4" hex bolts and lock washers.*
    - iii. *Attach the safety door latch block, PN 101-0914, to the top of the door plate using two 3/8" NC x 1-1/2" hex bolts and lock washers, and two 3/8" NC x 1-1/2" flat head countersunk cap screws.*
    - iv. *Attach safety door latch block, PN 101-1104, to the safety door latch block installed in step 42 (iii) using four 3/8" NC x 7/8" hex cap screws and lock washers.*
    - v. *Insert load plunger, PN AE12-306, into LH safety door latch block.*
    - vi. *Attach three 1/4" NPT JIC elbows to the Deltrol safety door valve, PN 08-0337M. Position a 15/16" valve lock nut as shown below, and secure the safety door valve to the safety door latch block using the valve lock nut (see illustration below).*

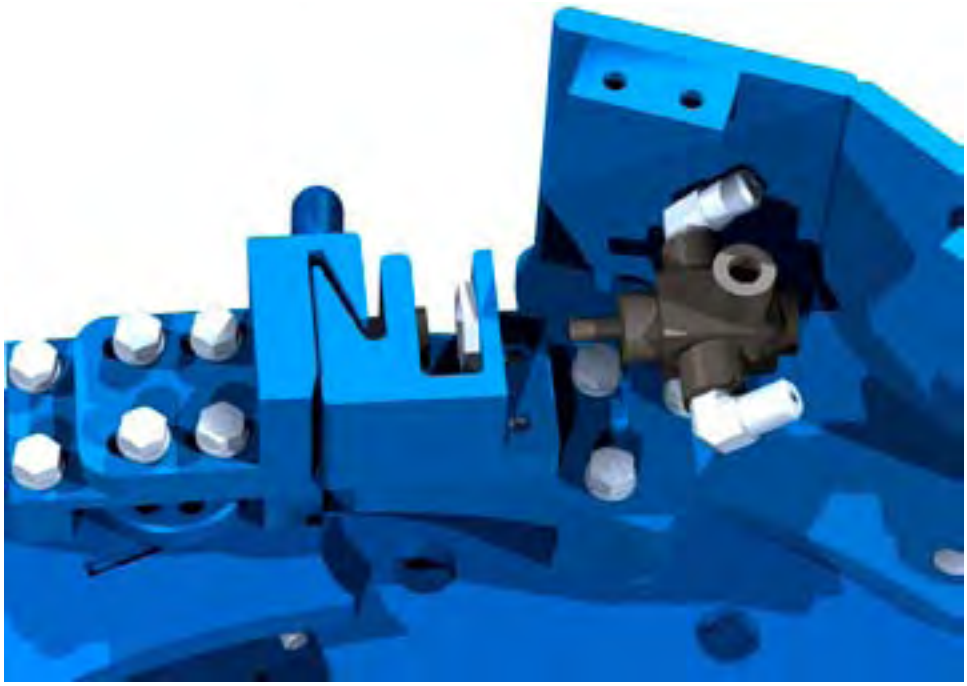

ILLUSTRATION 3.H.7: TONG ASSEMBLY - SAFETY DOOR SWITCH INSTALLATION

    - vii. *Attach the safety door switch guard plate, PN 101-1480, to the safety door switch guard weldment using three 3/8" NC x 3/4" hex bolts and lock washers.*
59. *Thread door cylinder mounting post (PN 1050-12-001) into top plate, just adjacent to the top LH brake band lug weldment.*
60. *Install door cylinder (PN 101-0069) - secure onto posts with 1/2" NC x 1/2" hex socket head shoulder bolts (UNC).*

Mechanical Assembly Procedure (Continued):

61. *Attach the rigid sling hanger weldments (LH weldment = PN 101-0150, RH weldment = PN 101-0151) to the top plate using two 3/8" NC x 1-3/4" bolts (outside), two 3/8" NC x 1" bolts (inside), and four 3/8" lock washers per hanger.*
62. *Install inlet coupling support assembly (PN 1050-C-175) to the top plate, between the RH pinion idler and RH rotary idler, using two 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the outlet coupling support base (PN 101-0023) to the top plate right of the pinion bearing cap using two 3/8" NC x 1" hex bolts and 3/8" lock washers, and attach the adjusting plate (PN 101-0022) to the support base using two 3/8" NC x 1" hex bolts, two 3/8" flat washers, and two 3/8" UNC nylock nuts.*
63. *Install two hydraulic valve mount weldments (PN 101-1442) to the top plate on either side of the brake band retainer using one 3/8" NC x 1" hex bolt and 3/8" lock washer per weldment.*
64. *Install the hydraulic valve assembly to the valve mount weldments using one 1/2" NC x 4-1/2" hex bolt and 1/2" narrow flat washer per valve mount. Install main inlet and outlet lines, and the remainder of the hydraulic connections. See the hydraulic schematic for hydraulic connections.*
65. *Slide the master lifting link (PN 02-0516) over the adjustment helix (PN 1053-1-H), and install the adjustment helix in the rigid sling weldment (PN 101-0112) using a 3/4" UNC x 8" hex bolt and 3/4" UNC nylock nut.*
66. *Use a crane to hoist the rigid sling weldment. Connect the rigid sling weldment to the rigid sling mounting lugs with rigid sling pins (PN 1053-C-1C). Secure each pin with two 0.148" x 2.938" hitch pins.*
67. *Thread a 3/4" UNC hex nut on to each of two rigid sling leveling adjustment weldments (PN 1053-C-1L). Thread the leveling adjustment weldments into the front of the rigid sling weldment mounting brackets, roughly adjusting them so the rigid sling is approximately perpendicular to the top plate of the tong (see illustration 3.H.10).*
68. *Thread 1/2" UNC hex nuts on to two 1/2" UNC x 1-3/4" hex bolts. Thread the bolts into the rear of the rigid sling weldment mounting brackets. (see following illustration).*

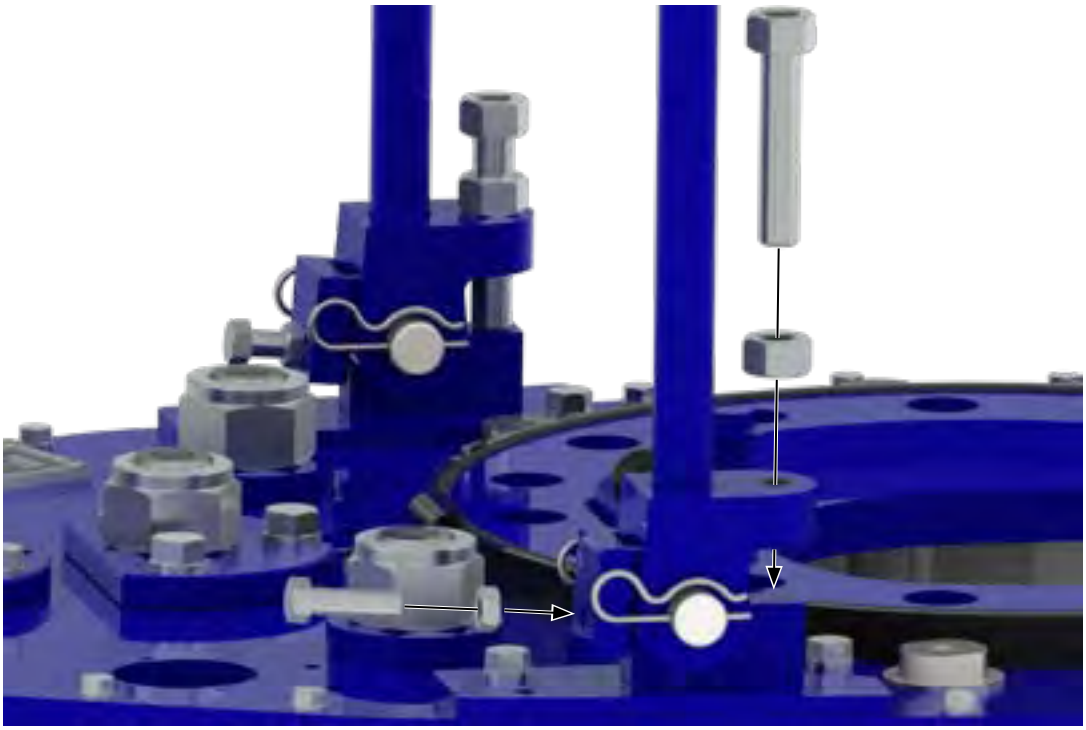

ILLUSTRATION 3.H.8: TONG ASSEMBLY - LEVELING BOLT INSTALLATION

69. *Use a crane and temporary sling to hoist the backup assembly onto a support structure next to the assembly location of the tong. Minimum height for the backup supports must be 36" in order to allow clearance for installing the front legs.*
70. *Attach the rear leg assembly to the tong:*
    a. *Position rear leg weldment on a flat surface near the tong assembly location.*
        - *Model 80-0420-16 uses rear leg weldment PN 101-4487*
        - *Model 80-0422 uses rear leg weldment PN 101-1547*
        - *Model 80-0421-3 uses rear leg weldment PN 101-1987*
    b. *Use a crane to hoist the tong assembly off the assembly surface. Bring the tong into contact with the rear leg, ensuring the crane continues to support the entire weight of the tong. Attach the rear leg weldment to the tong using two 1-1/4" UNC x 8" hex bolts and 1-1/4" UNC hex nylock nuts, and two 1" UNC x 7" hex bolts and 1" UNC hex nylock nuts.*

Mechanical Assembly Procedure (Continued):

71. *Use a crane and temporary sling to hoist the backup assembly onto a support structure next to the assembly location of the tong. Minimum height for the backup supports must be 36" in order to allow clearance for installing the front legs.*
72. ***80-0420-16 assembly (uses 85-0408 backup) only:*** *install the rear backup support spring assembly in the rear leg (see Pp. 5.40 - 5.41):*
    a. *Place two springs (PN 991-13) over the nubs on one of the two spring plate weldments (PN 101-4495). Place the second spring plate weldment over the springs and use four 1/2" UNC x 6" hex bolts, 1/2" narrow flat washers, and 1/2" UNC hex nylock nuts to fasten the assembly together.*
    b. *Install the spring support weldment in the rear leg using two 3/8" UNC x 9-1/2" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts. The location of the support can be changed as required when leveling the backup.*
73. ***85-0404 and 85-0506 backup assemblies only:*** *if using either of these backups ensure they are properly prepared for mating with the tong and rear leg assembly. Refer to Pp. 5.40 - 5.41.*
    a. *Thread a 1-1/4" UNC heavy hex nut on to the 1-1/4" UNC x 8" threaded rod (PN 101-1993).*
    b. *Coat at least 2" of thread on the threaded rod with red Loctite. Screw the threaded rod into the heavy hex bolt welded to the top plate of the backup until the rod bottoms out. Lock the threaded rod in place using the heavy hex nut threaded on to the rod in the previous step.*
    c. *Coat at least 4" of thread at the top of the threaded rod with red Loctite. Thread on a 1-1/4" UNC heavy hex nut, ensuring enough thread is exposed to allow installation of the suspension spring v-bracket and another 1-1/4" UNC heavy hex nut.*
    d. *Install the suspension spring v-bracket (PN 1483-500-00-04) on to the threaded rod, and secure with another 1-1/4" UNC heavy hex nut.*
74. *Remove the side panels from the backup.*
75. *Use a crane to hoist the tong and rear leg assembly and place in position over the backup. If using the 85-0604 or 85-0607-1 compression load cell-style backups the rear leg must be guided so that the "paddle" on the backup sits between the vertical plates of the rear leg when the tong and rear leg assembly is in position over the backup.*
76. *Hold a top spring cap (PN 1302-905-03B) under the top plate of the backup, and insert a front leg tube (PN 1302-904-905C) from the bottom of the backup, through the spring cap, and in to the leg mount weldment on the tong. Secure the leg tube with a 7/16" UNC x 4" hex bolt, 7/16" narrow flat washer, and a 7/16" UNC nylock nut. Repeat for the other leg tube.*
77. *Slide a leg spring (PN 1391-905-02B) over the bottom of each leg tube, followed by a bottom spring cap (PN 1302-905-03C). Secure each leg spring and bottom spring cap to the leg tube using a 7/16" UNC x 3" hex bolt, 7/16" narrow flat washer, and a 7/16" UNC nylock nut.*
78. ***85-0604 and 85-0606 backup assemblies only:***
    a. *Thread a 3/8" NC shoulder pattern 2-A eye bolt in to the tong body from the bottom of the top plate of the rear leg weldment, near the front of the rear leg (see Pp. 5.42 - 5.43).*
    b. *Connect one end of a rear backup support spring (PN 1391-905-03) to one of the eye bolts installed in the previous step, and the other end of the spring to the v-bracket installed in step 71d. Secure the end of the spring to the v-bracket using a spring retainer (PN 1480-500-00-04B) and a cotter pin. Repeat for the second spring.*
79. *Use a crane to hoist tong and backup assembly off the backup supports, and lower assembly so that it sits on its legs.*
80. *Install grease fittings:*
    a) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of each support roller shaft, including the door pivot rollers (10 locations total).*
    b) *Install one 1/4" straight thread grease fitting (PN 02-0097) into the top side of the latch adjustment cam.*
    c) *Install one 1/8" NPT grease fitting (PN 02-0005) into the top of each idler shaft or half-shaft (three locations total).*
    d) *Install one 1/8" NPT grease fitting (PN 02-0005) into the end of the clutch shaft, in the centre of the clutch bearing cap.*
    e) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in each pinion bearing cap (four locations total).*
    f) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) in clutch bearing cap (two locations total).*
    g) *Install one 1/8" NPT 90° grease fitting (PN 02-0093) or one 1/8" NPT 45° grease fitting (PN 02-0006) in the top of the motor mount.*
    h) *Install two 1/8" NPT 90° grease fittings (PN 02-0093) into the top plate of the backup directly above each clamping cylinder, and two into the bottom backup plate directly beneath each of the clamping cylinders (eight locations total).*
    i) *Install drive-in grease fittings (PN 02-0012) into the ends of each cage plate cam follower (26 locations total).*
81. *Install hydraulic inlet support base (PN 101-1138) to the top plate directly adjacent to the RH rotary idler, using two 3/8" NC x 1" hex bolts and 3/8" lock washers. Attach the adjustment plate (PN 101-0022) to the support base using two 3/8" NC x 1" hex bolts, 3/8" narrow flat washers, and 3/8" UNC hex nylock nuts.*
82. *Attach the outlet coupling support mounting base (PN 101-0021) to the top plate to the RH side of the motor mount using four 3/8" UNC x 2" hex socket head cap screws.*

Mechanical Assembly Procedure (Continued):

83. *Attach the outlet coupling support weldment (PN 101-0023) to the weldment mount using two 3/8" NC x 1" hex bolts and 3/8" lockwashers. Attach the adjustment plate (PN 101-0277) to the outlet support weldment using four 3/8" NC x 1" hex bolts, 3/8" narrow flatwashers, and 3/8" UNC hex nylock nuts.*
84. *Coat the threads of the hydraulic valve mounting posts (PN 101-0116) with Loctite and thread into the top plate just behind the brakeband on either side of the brakeband retainer.*
85. *Mount the DVA35 hydraulic valve assembly on the mounting posts using two 1/2" UNC x 4-1/2" hex bolts and 1/2" narrow flatwashers.*

I. DAILY INSPECTION & MAINTENANCE CHECKLIST (POWER TONG)

Farr recommends that the following inspection and maintenance procedures be performed before each use, and at least once per day when the tong is in steady use, in the order in which they are listed.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

2. ☐
   1) *Rotate the tong to the "open throat" position. Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder*
   2) *De-energize the power unit.*
   3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   4) *Remove the hydraulic SUPPLY line from the equipment.*
   5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   7) *Disconnect the hydraulic RETURN line from the equipment.*
   8) *Disconnect remaining hoses such as case drains.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Perform an initial wash of the tong in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
5. ☐ *Use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*
6. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners. Farr recommends that damaged or missing body parts be repaired or replaced.*
7. ☐ *Inspect the jaws and dies. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, replace the entire jaw assembly. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely. Check to ensure the size of the loaded jaws match the size of casing or pipe you are running.*
8. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service.*
9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*
10. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
11. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*
12. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object.*

13. ☐ *Perform a complete greasing of the tong - refer to Maintenance section of the technical manual*

14. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines, and, if applicable, the electrical line to the turns counter.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

15. ☐ *Perform a visual inspection of the load cell. If using a tension load cell, replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect hydraulic line, fittings, and diaphragm seals for fluid leaks.*

16. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

17. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

18. ☐ *Perform a visual inspection of pressurized hydraulic lines. Document and correct any hydraulic fluid leaks.*

19. ☐ *Perform a full functional test of the tong (refer to section 2.I.4).*

20. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

21. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

J. DAILY INSPECTION & MAINTENANCE CHECKLIST (BACKUPS)

Farr Canada recommends that the following inspection and maintenance procedures be performed before each use, and at least once per day when the backup is in steady use, in the order in which they are listed.

Do not perform any maintenance while the tong and backup assembly is connected to any hydraulic power supply. Farr Canada recommends that all hydraulic lines are fully disconnected, and residual hydraulic pressure is bled off. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid.

ALL UNITS

1. ☐ *Perform an initial wash of the backup in order to remove the majority of dirt and grease build-up.*
2. ☐ *Perform an external inspection. Check to ensure there are no loose or missing fasteners - replace if necessary.*
3. ☐ *Check to see if backup is parallel to the tong - if the backup is resting at an angle, one of the front leg springs is likely broken or fatigued to the point it must be replaced.*

WEDGE BACKUP ONLY

4. ☐ *Remove access cover from top plate. Perform a visual inspection ot the interior of the backup - use a flashlight if necessary. Premature wear where there are moving parts (bare metal where there used to be paint, and metal shavings in the grease are good indicators) may show where a component needs to be adjusted, or if necessary, replaced.*
5. ☐ *Inspect latch mechanism to ensure the door latch plate completely engages the door. Adjust or replace if necessary.*
6. ☐ *Grease UC-300 slider pads, ram guides, door cylinder pivots, and door pivots.*

CLINCHER BACKUP ONLY

4. ☐ *Use a flashlight to perform a visual inspection of the interior of the backup - remove one side panel if necessary. Premature wear where there are moving parts (bare metal where there used to be paint, and metal shavings in the grease are good indicators) may show where a component needs to be adjusted, or if necessary replaced. Replace any removed panels when inspection is complete.*
5. ☐ *Grease clincher cylinder guides using the grease fittings on the top body plate.*
6. ☐ *Ensure the splines on the clincher cylinder faces, and on the rear of the die are clean and free of debris before inserting clincher die. If die are already installed, ensure fasteners in the die retainers are tightly secured.*
7. ☐ *Inspect rear spring hanger assembly. Ensure all eye bolts, shackles, and cotter pins are in place and in good condition.*
8. ☐ *Inspect clincher cylinders for hydraulic fluid leaks once the system pressure has been restored.*

FARR-STYLE BACKUP ONLY

4. ☐ *Inspect cam ring gear for broken teeth.*
5. ☐ *Lubricate the cam follower array.*
6. ☐ *Inspect the jaws and dies. Inspect the jaw roller pins for signs of damage - replace pins if necessary. If the pins are welded in place, replace the entire jaw assembly. Ensure dies are secure in the jaw - replace worn dies if necessary. Ensure that the jaw rollers rotate freely. Check to ensure the size of the loaded jaws match the size of casing or pipe you are running.*
7. ☐ *Inspect front and rear cam cylinder supports. Repair or replace any parts that are broken, cracked, or bent.*
8. ☐ *Inspect rear spring hanger assembly. Ensure all eye bolts, shackles, and cotter pins are in place and in good condition.*
9. ☐ *Open the backup door and inspect the condition of the latch. Repair or replace damaged latch components. If latch appears to be in good condition, close the door, then tug firmly on it to ensure the door remains latched.*

ALL UNITS (AFTER STARTING POWER UNIT)

10. ☐ *Perform a visual inspection of pressurized hydraulic lines - document and correct any hydraulic fluid leaks.*
11. ☐ *Perform a full functional test of the backup. Document and correct hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are in use on the backup.*

K. MONTHLY MAINTENANCE CHECKLIST - POWER TONG

The following maintenance checklist is intended as a guideline rather than a definitive maintenance schedule. Your equipment may require more, or less, maintenance depending upon the frequency of use, the percentage of maximum torque that your equipment is routinely subjected to, and the field conditions under which your equipment operates. Farr recommends that the following inspection and maintenance procedures be performed monthly, or in conjunction with your maintenance foreman's experience and best estimate of when your equipment is due for this maintenance.

1. ☐ *Rotate cage plate/rotary gear until the opening in the rotary gear faces towards the rear of the tong.*

DO NOT PERFORM ANY FURTHER ACTIONS OR MAINTENANCE WHILE THE TONG IS CONNECTED TO ANY HYDRAULIC POWER SUPPLY. FARR RECOMMENDS THAT ALL HYDRAULIC LINES ARE FULLY DISCONNECTED, AND RESIDUAL HYDRAULIC PRESSURE IS BLED OFF. ENSURE ADEQUATE CONTAINMENT IS IN PLACE TO PREVENT ENVIRONMENTAL CONTAMINATION FROM RESIDUAL HYDRAULIC FLUID.

DEPRESSURIZE HYDRAULIC SYSTEM IN PREPARATION FOR MAINTENANCE:

2. ☐
   1) *De-energize the power unit.*
   2) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
   3) *Remove the hydraulic SUPPLY line from the equipment.*
   4) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
   5) *Disconnect the hydraulic RETURN line from the equipment.*
   6) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE INJURIES

3. ☐ *Clean the exterior of the tool thoroughly, using either water (if using a pressure washer ensure a low-pressure wash wand is used), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*

4. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*

5. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*

6. ☐ *Inspect all fasteners and fastener safety wires (if equipped). Replace any missing fasteners - use Grade 8 bolts only unless otherwise specified. Re-torque all external fasteners to SAE specifications.*

7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*

8. ☐ *Perform a visual inspection of all fasteners and protruding body pieces (example: hydraulic valve mounts, inlet & outlet line supports, tong legs, shifter handle pivot lugs). Tighten or replace loose or missing fasteners.*

9. ☐ *Inspect tong for signs of premature wear, or moving parts that are rubbing (bare metal where there used to be paint is a good indication of wear.*

10. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to the tong being returned to service. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint color number RAL7015, "McCoy Yellow" (hazard areas) is RAL1007, and McCoy Green is RAL6029 (contact Farr sales for paint number for custom paint applications). Allow sufficient time for paint to dry before proceeding.*

11. ☐ *Visually inspect all load-bearing welds. Any weld that is cracked or separating must be repaired and repainted before returning the tong to service.*

12. ☐ *Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. Refer to Section 2A of the technical manual (Sling/Load Bearing Device Safety) for information on recommended testing and recertification. Please note that turnbuckles with part number 101-3086 (short turnbuckles) use a high-strength pin which must be supplied by Farr.*

"SHORT" TURNBUCKLES HAVING PART NUMBER 101-3086 EMPLOY HIGH-STRENGTH PINS WHICH MUST BE SUPPLIED BY FARR.

13. ☐ *Remove hydraulic motor and rotate the gear train by hand, and use a flashlight to perform a visual inspection of the gear train through the access panel and the opening of the rotary gear while the gear train is being rotated. If gear damage or chips of metal are seen, the tong should be removed from service and overhauled to avoid further damage. Replace access panel when inspection is complete.*

14. ☐ *Inspect all jaws and dies in use for the maintenance interval. Remove pin & roller, and inspect for signs of damage - replace pins if necessary. If the pins are welded in place & the welds are found to be damaged, remove and quarantine the jaw until the weld is repaired. Clean the pins and rollers, and reassemble using a liberal coating of anti-seize compound. Ensure dies are secure in the jaw & die retainers are present. Replace worn dies if necessary. Ensure that the jaw rollers rotate freely.*

15. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*

16. ☐ *Inspect top and bottom brake band linings - replace if lining is found to be flaking or is missing pieces of material. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

17. ☐ *Inspect door springs. Ensure the springs retain sufficient strength to be able to assist the opening of the door, and to keep the door open. The springs should also help to "snap" the door shut.*

18. ☐ *Inspect backup springs (if applicable). The rear extension springs (where used) should be equally extended, and the front leg springs should be equally compressed. Ensure that neither of the rear backup springs have been over-extended and lack sufficient tension to adequately support the backup. Ensure that neither of the front leg springs (or, when installed, the single rear backup leg spring) have been over-compressed, and still retain enough spring strength to support the front of the backup.*

19. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

20. ☐ *Perform a visual inspection of all hydraulic lines. Replace flexible lines if they appear to be cracked, fatigued, or have visible signs of wear from contact with a rigid object. If your tong is equipped with rigid hydraulic lines, replace any line that is dented or appears to be stressed or cracked.*

21. ☐ *Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear. Perform a full lubrication - refer to Maintenance section of manual to determine lubrication points.*

22. ☐ *Ensure main supply and return connections to the tong are fully made up. Re-connect the remainder of the hydraulic lines.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

If using a stand-alone power unit, start it now - refer to the power unit technical manual for startup procedures. Listen to power unit for a moment to see if there are any unusual mechanical sounds (rubbing, grinding, excessive pump noise). If using a diesel unit, allow sufficient time for the engine to reach operating temperature before increasing engine RPM. Once engine is warm, gradually increase engine RPM until operating speed is reached.

23. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*

24. ☐ *Perform a visual inspection of pressurized hydraulic lines. If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

25. ☐ *Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

26. ☐ *Energize power unit. Rotate tong for one minute in both high and low gear. Stop the tong and reverse the direction of rotation for another minute in both high and low gear, ending with the opening of the rotary gear facing the gear train.*

27. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

28. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service.*

29. ☐ *Rotate tong in high gear for 5 minutes while monitoring temperature of top and bottom bearing caps. If the bearing caps are hot to the touch (higher than approximately 50°C) replace the applicable bearings. Likewise if the tong is making unusual noises check for damaged bearings (see Maintenance Manual for all bearing locations).*

30. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression. Inspect load cell for damage or signs of stress. Check oil level in load cell and fill if necessary (refer to technical manual Section 7 or Section 8).*

31. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*

32. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*

33. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands.*

34. ☐ *Perform a full functional test of the tong including, if applicable, backup components, lift cylinder, and float frame components (refer to Section 2.I.4). Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

35. ☐ *Test safety door feature (if equipped). Begin rotating the tong at low speed, and open the tong door(s). If rotation does not immediately stop, this is an indication that the safety door mechanism is not operating correctly and the tong must be removed from service until the mechanism is repaired. Repeat the test while operating the tong in the opposite direction. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

36. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external unpainted surfaces (and chain slings) EXCEPT cylinder rods, jaw rollers, and rotary gear camming surfaces. Refer to manufacturer data sheets for proper application and safety information.*

Once all of the above maintenance checklist items have been satisfactorily completed the tool may be returned to service.

L. TUBULAR CONNECTION EQUIPMENT DE-COMMISSIONING & SHIPPING

Perform the following decommissioning procedures when removing tubular connection equipment from service, with the intent of short to long-term storage. These procedures are essential for ensuring proper protection of the equipment from environmental attack, and to aid in the quick turnaround when returning the equipment to service.

Store all o-rings, seals, packings, gaskets, etc. in strong moisture proof, airtight containers. Ensure that these items are not crushed, nicked, or otherwise damaged.

Do not perform any further actions or maintenance while the tong is connected to any hydraulic power supply. Farr recommends that all hydraulic lines are fully disconnected, and residual hydraulic pressure is bled off. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid.

IN ORDER TO MAINTAIN THE INTEGRITY OF INSTALLED SEALS, MCCOY RECOMMENDS THAT THE MAXIMUM STORAGE INTERVAL NOT EXCEED ONE YEAR. AT LEAST ONCE PER YEAR ALL TUBULAR CONNECTION EQUIPMENT IN LONG-TERM STORAGE SHOULD BE RECOMMISSIONED AS PER SECTION 3.M. IF FURTHER STORAGE IS REQUIRED, THE EQUIPMENT SHOULD THEN BE PUT THROUGH ANOTHER DE-COMMISSIONING PROCEDURE.

DEPRESSURIZATION PROCEDURE IN PREPARATION FOR STORAGE:

1) *Rotate the tong so that the opening in the rotary gear faces the gear train (towards the rear of the tong). Ensure tong and backup doors (if equipped) are closed. Fully extend the lift cylinder (if equipped). If mounted in a frame, retract the float cylinders (if equipped).*
2) *De-energize the power unit.*
3) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
4) *Remove the hydraulic SUPPLY line from the equipment.*
5) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Disconnect the hydraulic RETURN line from the equipment.*
8) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

HYDRAULIC PRESSURES AS HIGH AS OPERATING PRESSURE MAY REMAIN TRAPPED IN SMALL AREAS OF THE EQUIPMENT. ENSURE ALL MAINTENANCE IS CARRIED OUT BY A QUALIFIED SERVICE TECHNICIAN, AND THAT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT IS USED TO GUARD AGAINST PRESSURE-INDUCED INJURIES

1. ☐ *Perform an initial wash of the tool in order to remove the majority of dirt and grease build-up. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid and dirty grease.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Clean the interior of the tong thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents. Make a note if any metal shavings or metal pieces are flushed out of the gear train cavity - if shavings or metal pieces are seen the tong must be overhauled before it is returned to service.*
4. ☐ *Clean the exterior of the tool thoroughly, using either water (do not use a pressure washer), or an appropriate solvent-based grease-cutting cleaner such as Varsol. Ensure adequate containment is in place to prevent environmental contamination from residual hydraulic fluid, dirty grease, and cleaning agents.*
5. ☐ *Inspect all fasteners and fastener safety wires. Replace any missing fasteners - use Grade 8 bolts only. Re-torque all external fasteners to SAE specifications.*
6. ☐ *Inspect backing pin(s). If cracked, broken, or bent it (they) must be replaced.*
7. ☐ *Repair or replace any damaged or missing external body parts, such as torque gauge mounts, hydraulic supports, safety door protectors, etc.*
8. ☐ *Inspect all paint - locations in which the paint has been damaged must be repaired prior to storage. Prepare areas to be painted to ensure they are free of grease, dirt, or solvent. Touch up using a solvent-based acrylic paint - "McCoy Grey" is paint number RAL7015. Allow sufficient time for paint to dry before proceeding.*
9. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
10. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*
11. ☐ *Energize power unit.*

12. ☐ *Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train. De-energize the power unit, and perform another generous lubrication of the gear train, including the gear housing.*

13. ☐ *Energize power unit. Rotate tong for one minute, stop, and reverse the direction of rotation for another minute, ending with the opening of the rotary gear facing the gear train.*

14. ☐ *De-energize the power unit, and perform a third generous lubrication of the gear train, including the gear housing.*

15. ☐ *Energize power unit, and rotate the tong for a final time, one minute in one direction, stop, and reverse the direction of rotation for another minute, this time ending with the rotary gear in the "open throat" position.*

16. ☐ *Extend all hydraulic cylinders, and inspect cylinder rods for signs of mechanical damage, flaking, or rust. Farr recommends that damaged cylinders be replaced prior to storage.*

17. ☐ *If you are using a frame-mounted tool, the tong must be lowered onto the backup in order to remove the risk of sudden and catastrophic movement when pressure is removed from the float cylinders. Cover the top of the backup with protective cloth to protect the paint on the backup. Place two wooden beams across the top of the tong, ensuring that the beams have a minimum size of 4" x 4" x the width of the tong. Cover the tops of the wooden beams with more protective cloth to prevent paint damage to the tong. When lowering the tong onto the beams, ensure that the beams come into flat contact with the bottom of the tong, away from bearing caps, brake bands, or other protrusions on the bottom of the tong. Ensure that the tong hanger chains are loose, but not dangling into contact with the hangers or top plate of the tong.*

DEPRESSURIZATION PROCEDURE FOR STORAGE:

1) *Rotate the tong to the "open throat" position.*
2) *Exercise each hydraulic cylinder several times - open the tong and backup doors (if equipped), retract and extend the remote backing pin ramp (if equipped), retract and extend the float cylinders. Leave all cylinders except for the door cylinders in their fully retracted position. The general idea is to have as little of the chrome cylinder rods exposed as possible.*
3) *De-energize the power unit.*
4) *Repeatedly actuate the tong motor control valve lever IN BOTH DIRECTIONS to dissipate any residual pressure in the valve and motor.*
5) *Remove the hydraulic SUPPLY line from the equipment.*
6) *Repeatedly actuate the remaining control valve levers IN BOTH DIRECTIONS to dissipate any residual pressure in the remainder of the hydraulic control system.*
7) *Connect a low-pressure air supply line (10 PSI or less) to the hydraulic supply line, and force a small amount of the remaining hydraulic fluid from the valve assembly - this will allow for thermal expansion of the hydraulic fluid if the equipment is stored or transported in high ambient temperatures. Failure to do this may result in damaged or destroyed seals in the equipment.*
8) *Disconnect the hydraulic RETURN line from the equipment.*
9) *Disconnect remaining hoses such as case drains, or lines connected to the turns counter.*

18. ☐ *If any hydraulic fittings or hoses are leaking they must be repaired or replaced before proceeding.*

19. ☐ *Wipe all excess grease from outside of equipment. Replace the access door panel. Use a solvent-based cleaner on rags to wipe all external surfaces to remove residual grease or hydraulic fluid. Once the outside surfaces have been de-greased, wipe all external surfaces with clean water to remove residual solvent.*

20. ☐ *Farr recommends that chain slings be removed and stored separately. Rigid slings and other rigid suspension devices may remain in place.*

21. ☐ *Apply grease or heavy oil to all exposed cylinder rods.*

22. ☐ *Farr recommends that an anti-corrosive agent such as Tectyl® 506 be applied to all external surfaces EXCEPT cylinder rods (including chain slings). Refer to manufacturer data sheets for proper application and safety information.*

DO NOT ALLOW ANTI-CORROSIVE AGENTS TO CONTACT CYLINDER RODS. CYLINDER ROD DAMAGE WILL OCCUR.

23. ☐ *Allow the anti-corrosive coating ample time to dry - refer to manufacturer data sheets for drying times at room temperature.*

24. ☐ *Wrap entire assembly in 100 gauge (1 mil) corrosion-inhibiting wrap, at least 3 layers thick. Attempt to ensure that the tool is well-sealed within the wrapping, including the bottom.*

If possible, store in a sealed, climate controlled environment. If isolated storage is not available, Farr recommends storing your wrapped equipment in a secure, out-of-the-way location, using silica gel desiccant to reduce the humidity within the wrapping. As a guideline, use 125 g. of desiccant for each cubic metre of space, or 3.5 g. per cubic foot (see calculations next page).

CALCULATION OF REQUIRED DESICCANT

1) *Calculate the trapped air volume by measuring the outside dimensions of the tool to be stored, and treat that as the volume to be stored. For example, the external dimensions of a KT20000 20" power tong are 80.25" x 50.5" x 28", which calculates to an approximate volume of 113500 in^3, or 66 ft^3 (1.87 m^3).*

2) *Multiply the calculated air volume, in cubic feet, by the recommended amount of desiccant per cubic foot. Carrying forth the example used in the previous step, the required desiccant charge would be 3.5 g. x 66 ft^3, equaling 231 g. Several manufacturers offer silica gel desiccant in packaged quantities of 125 grams per bag, so two packages of desiccant would be required. Please keep in mind that this is a guideline only - more or less desiccant may be required in extreme environmental conditions.*

For best corrosion resistance the equipment should be removed from storage and exercised on a regular basis, depending on the storage environment. Farr recommends that for equipment stored in a salt-water maritime or exposed dusty environment, repeat steps 9 through 24 monthly. For equipment stored in isolated storage in a non-maritime environment, repeat steps 9 through 24 quarterly. Replace desiccant packs at this time - depleted desiccant packs may be treated as regular dunnage.

SHIPPING INSTRUCTIONS

The following procedure lists the steps to be followed to prepare your tong for shipping.

1. *If not already done remove accessories (tong jaws, load cell, torque gauge, etc.) McCoy recommends wrapping these items in protective wrap and placing in a separate wooden crate.*
2. *Place the equipment on a sturdy pallet constructed of 4" x 4" cross-members and 2" x 4" flooring. McCoy recommends placing a 2" x 6" board across the width of the tong under the legs (see Illustration 3.M.1). Ensure the pallet is large enough to accommodate the wooden crate containing the tong accessories.*

ILLUSTRATION 3.L.1: SHIPPING INSTRUCTIONS - PALLET

SHIPPING INSTRUCTIONS (CONTINUED):

3. *Use a crane to support the chain sling (if equipped). Wrap the chain sling with bubble wrap or another similar protective wrapping, and secure the wrapping with tape. Lower the wrapped chain sling so it sits inside the opening of the tong.*

ILLUSTRATION 3.L.2: SHIPPING INSTRUCTIONS - WRAPPING CHAIN SLING

4. *Do not allow the backup (if equipped) to "float" on its support springs during shipping. Build a sturdy wooden support structure under the front and back of the backup to support the weight of the backup and release the compression on the springs. Strap the backup to the support blocks and pallet independent of the tong, using minimum 3/4" x 0.029" metal strapping in at least two locations. Place strapping as close to the backup supports as possible, and use caution not to entrap any flexible hydraulic hoses beneath the strapping. Before tightening strapping, place strapping protectors wherever the metal strapping comes into contact with the equipment.*

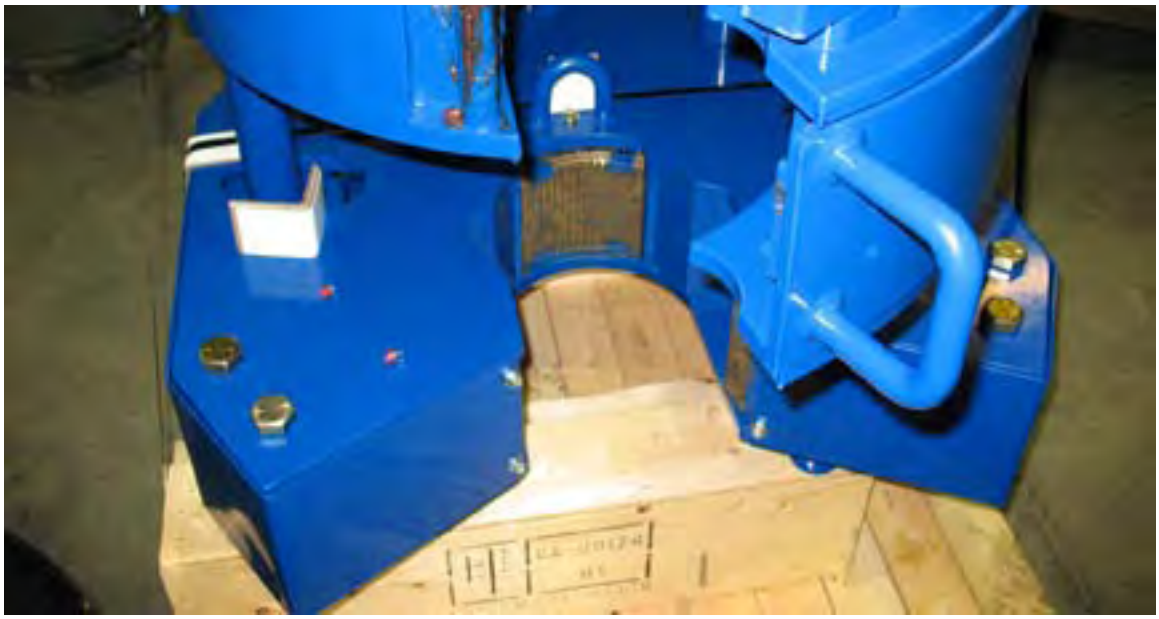

ILLUSTRATION 3.L.3: SHIPPING INSTRUCTIONS - BACKUP SUPPORT

SHIPPING INSTRUCTIONS (CONTINUED):

5. *Securely strap the equipment in place using metal strapping. Place strapping as close to the cross-members under the equipment legs as possible, and use caution not to entrap any flexible hydraulic hoses beneath the strapping (guide strapping through beneath the hydraulic hoses). Use the following guidelines to determine the strapping requirements:*

   Assemblies weighing 1000 lbs. (454 kg.) or less:

   3/4" x 0.029" metal strapping, 3320 lbs. (1509 kg.) tensile strength
   Minimum two straps

   Assemblies weighing more than 1000 lbs. (454 kg.) or less:

   1-1/4" x 0.031" metal strapping, 5500 lbs. (2500 kg.) tensile strength
   *Minimum **two** straps for assemblies weighing less than 5000 lbs. (2273 kg.)*
   *Minimum **three** straps for assemblies weighing more than 5000 lbs. (2273 kg.)*

   Before tightening strapping, place strapping protectors wherever the metal strapping comes into contact with the equipment.

   Place the wooden crate containing the tong accessories on the crate next to the equipment. Strap the crate to the pallet using 3/4" x 0.029" metal strapping (see Illustration 3.M.4).

ILLUSTRATION 3.L.4: SHIPPING INSTRUCTIONS - STRAPPING EQUIPMENT TO PALLET

   If it is not practical to place larger loose items in a wooden crate, ensure they are also securely strapped to the pallet using 3/4" x 0.029" metal strapping.

6. *Use a large polyethylene shipping bag (sometimes called a pallet cover) to completely enclose the equipment. Seal polyethylene bag to the pallet using 1 mil polyethylene wrap. Use the wrap to conform the plastic cover to the general shape of the equipment, but do not wrap so tight that sharp edges on the equipment perforate the cover.*

7. *McCoy recommends enclosing the equipment in a sturdy shipping crate which is securely fastened to the pallet.*

N. TUBULAR CONNECTION EQUIPMENT RE-COMMISSIONING PROCEDURE

Perform the following recommissioning procedures when removing tubular connection equipment from short or long-term storage back into regular service. These procedures are essential for ensuring proper equipment preparation and operation. The following procedures also assume that the decommissioning and storage procedures recommended by Farr have been strictly observed.

1. ☐ *Remove all protective plastic wrapping. If there are desiccant packs with the assembly, they may be disposed of with the regular garbage.*
2. ☐ *Remove the access panel on the side of the tong directly adjacent to the shifter mechanism.*
3. ☐ *Wipe excess grease or heavy oil from exposed cylinder rods.*
4. ☐ *If applicable, re-connect chain sling to lifting lugs. Perform a visual inspection of all lifting points - if visible damage is seen, including cracks, broken lugs, distorted metal, etc. replace damaged part(s) before placing tong in service. Also inspect all chains, master links, and turnbuckles - again, if any damage is noted replace the damaged part(s) before placing the tong in service. If your company requires yearly certification of lifting equipment, ensure that the most recent test date falls within the past year. Perform recertification if necessary.*
5. ☐ *Perform a liberal lubrication of the equipment - refer to Maintenance section of manual to determine lubrication points. Generously fill the gear train housing with grease through the access panel, and also through the opening in the rotary gear.*
6. ☐ *Connect the equipment to a hydraulic power unit. Ensure all lines are fully made up to prevent equipment damage from excessive back pressure. Do not neglect to connect the motor drain.*

FAILURE TO ENSURE THAT THE SELF-SEALING SUPPLY AND RETURN LINES ARE FULLY MADE UP MAY RESULT IN CATASTROPHIC EQUIPMENT FAILURE.

7. ☐ *Energize power unit.*
8. ☐ *Ensure that supply pressure is at or above the tong's specified operating pressure, and that the return pressure is less than 350 psi.*
9. ☐ *Perform a thorough inspection of pressurized hydraulic lines and fittings. Any leaking hydraulic fluid lines or fittings must be replaced before the equipment is returned to service.*
10. ☐ *Perform a thorough inspection of all seals. Any seal that is leaking or "weeping" must be replaced before the equipment is returned to service.*
11. ☐ *Rotate tong in low gear for 5 minutes while monitoring pressurized seals and hydraulic lines. If a seal, line, or fitting begins to leak while tong is rotating, it must be replaced before the equipment is returned to service. Finish this step with the rotary gear opening facing the gear train. De-energize the power unit.*
12. ☐ *Inspect all flexible hydraulic lines for signs of wear, blistering, or any other signs of potential failure - replace if signs of potential failure are identified.*
13. ☐ *Inspect the gear train housing. If the amount of grease is inadequate, liberally grease the gear train through the access panel, and through the opening in the rotary gear.*
14. ☐ *Inspect top and bottom brake band linings - replace if necessary. Unequal wear of the brake bands indicates that the brake band tension is not evenly adjusted. Refer to the maintenance section of the manual for instructions on properly adjusting brake bands. Ensure that all grease is wiped from brake band linings and the parts of the cage plates that come into contact with the brake band linings*
15. ☐ *Re-install access panel. Install a set of pre-inspected jaws that are the correct size for the pipe or casing being run.*
16. ☐ *Install load cell. If using a tension load cell, perform a visual inspection and replace any cracked, broken, or distorted components including links and chains. If using a compression load cell, replace any component that has been crushed or otherwise distorted through compression.*
17. ☐ *If applicable, inspect the load cell anchor pins (tension load cell only). Replace the anchor pins if cracking or metal distortion is seen.*
18. ☐ *If applicable, the weld securing the single load cell anchor to the bridge bar main plate must be inspected (compression load cell only). If the integrity of the weld has been compromised, the tong must be removed from service until the weld is repaired. The load cell beam will need to be disconnected and removed so the weld is visible. Before re-installing the beam, liberally grease the anchor pin before reinserting into the load cell beam.*
19. ☐ *Re-energize power unit.*

20. ☐ *Perform a full functional test of the equipment including, if applicable, backup components and float frame components. Report and correct any hydraulic leaks from the hydraulic valve bank, or from any hydraulic cylinders that are used.*

21. ☐ *If using a frame-mounted tong and backup system, raise the tong off the beams that it is resting upon. Remove the beams and protective cloths - inspect the paint on top of the backup and the bottom of the tong to ensure it has not been damaged by the beam.*

22. ☐ *Test safety door feature (if equipped). Open the tong door(s), and attempt to rotate the cage plate at low speed (low gear) in both directions (makeup and breakout). If cage plate begins rotating, the safety door mechanism is not functional, and the tong must be removed from service until the safety door mechanism can be repaired. If the safety door is operating correctly, cage plate rotation will not be inhibited once the door is closed and latched.*

NEVER OPERATE YOUR EQUIPMENT WITH A BYPASSED OR MALFUNCTIONING SAFETY DOOR

23. ☐ *While rotating the cage plate, ensure that the jaws properly cam. If the jaws do not cam properly, the brake bands need to be tightened. Incrementally adjust both the top and bottom brake bands EQUALLY until proper cam action is achieved.*

24. ☐ *When all of the previous steps are completed, you may return your re-commissioned equipment to service.*

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Adequate maintenance and proper fluid selection is essential for minimizing hydraulic-related failures. All troubleshooting must be performed by a technician trained in hydraulic systems, and familiar with the equipment design, assembly and operation.

The following troubleshooting instructions are intended to be guidelines only. Any faults not solved through the use of this guide should be referred to our engineering department for their evaluation and recommendations.

A. TONG WILL NOT DEVELOP SUFFICIENT TORQUE

	POSSIBLE PROBLEM	SOLUTION(S)
1	Malfunctioning relief valve on tong hydraulic circuit	See Section 4.B, Relief Valve Troubleshooting
2	Directional valve is leaking	Check directional valve. Neutral position should return fluid directly to the reservoir. Replace or repair valve to ensure correct operation
3	Power unit is not producing adequate pressure	Troubleshoot power unit (see user's manual for your particular unit)
4	Poor hydraulic pressure at the tong despite adequate pressure at the power unit, or excessive back pressure in the return line.	Restrictions exist in line between power unit and tong. Inspect integrity of self-sealing couplings to ensure they are allowing full fluid flow. Check to ensure no other restrictions exist (contaminated catch screens or filters, for example)
5	Fluid viscosity is not appropriate (too high or too low)	Ensure hydraulic fluid being used is the viscosity recommended by McCoy Drilling & Completions. Power unit pump may not prime if fluid is too heavy, and the hydraulic system will overheat if fluid is too light. Replace with proper viscosity fluid
		Hydraulic fluid viscosity is affected by environmental conditions. Ensure the fluid being used is suitable for high or low temperatures. Replace with proper viscosity fluid for the operating conditions if necessary
6	Worn or damaged tong motor causing slippage	Replace or repair worn or damaged motor
7	Damaged bearings or gears causing excessive drag	Replace or repair worn or damaged gears or bearings
8	Jaws slipping on pipe	Ensure jaw dies are not worn to the point that they cannot grip. Ensure the correct sized jaws are in use
9	Torque gauge is indicating incorrectly	Incorrect gauge is being used. Ensure gauge is the proper range, and has been properly calibrated for the arm length of the equipment in use
		Gauge has been damaged. Check gauge operation and calibration on independent system
		Gauge has mistakenly been married to an incorrect load cell
10	Load cell is measuring incorrectly	Incorrect load cell is being used
		Air is trapped in torque measuring circuit (load cell, hydraulic line, or gauge. Refer to torque measurement troubleshooting in Section 6 of this manual
		Load cell has been damaged. Replace load cell, or return to McCoy for repair and re-calibration

MCCOY DRILLING & COMPLETIONS GUARANTEES CALIBRATION OF A LOAD CELL/TORQUE GAUGE ASSEMBLY FOR A PERIOD OF ONE YEAR. MCCOY SUGGESTS THAT THE LOAD CELL/TORQUE GAUGE ASSEMBLY BE RETURNED TO THE FACTORY FOR RE-CALIBRATION ON A YEARLY BASIS.

	POSSIBLE PROBLEM	SOLUTION(S)
11	Incorrect motor speed selected (applies to 2-speed motors only)	Maximum torque can only be developed when LOW motor speed (maximum hydraulic displacement) is selected.
12	Incorrect tong gear selected	Maximum torque can only be developed when LOW motor gear is selected

B. RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING

	POSSIBLE PROBLEM	SOLUTION(S)
1	Relief pressure set too low, resulting in insufficient tong torque	Adjust setting (See following procedure):
	Relief pressure set too high, resulting in crushed pipe or gear train failure	

a. If your tong is equipped with a system pressure indicator proceed to step "f". If your tong does not have a system pressure indicator, a temporary 0 - 3000 PSI indicator must be installed on the hydraulic inlet.

b. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.

c. Tee in a temporary indicator at the safety door supply pressure port. Ensure all hydraulic connections are performed by a qualified hydraulic technician.

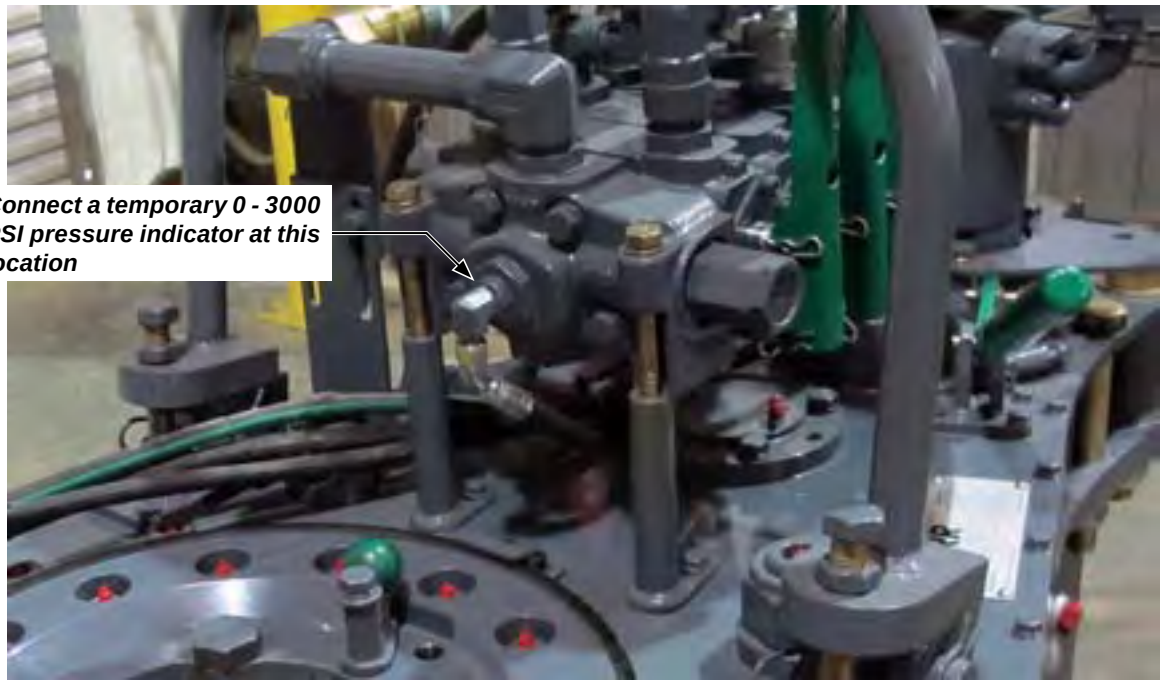


ILLUSTRATION 4.B.1: RELIEF VALVE TROUBLESHOOTING - TEMPORARY GAUGE INSTALLATION

d. Re-establish hydraulic power to your tong. Ensure that no equipment functions are active.

e. Loosen the locking nut on the pressure relief valve.

f. Open the tong door to activate the safety door system and inhibit tong rotation.

g. Activate motor control valve. Observe the pressure displayed on the pressure indicator. Adjust the relief valve until the pressure indicated is at the maximum system pressure specified on the specifications page (maximum system pressure is the pressure at which your tong achieves its specified torque).

DO NOT ADJUST PRESSURE RELIEF TO A SETTING THAT ALLOWS HIGHER THAN MAXIMUM SYSTEM PRESSURE. DOING SO CREATES A POTENTIAL FOR SERIOUS INJURY OR DEATH, AND MAY CAUSE CATASTROPHIC EQUIPMENT FAILURE.

h. Release the motor control valve and tighten the locking nut on the pressure relief valve.

i. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D.

j. Close the tong door, and remove the temporary pressure indicator. Restore the safety door pressure supply line to factory specifications. Verify that safety door is operating correctly (see section 2.I.5.k).

Continued on next page

RELIEF VALVE IS INCORRECTLY SET OR NOT FUNCTIONING Cont'd:

	POSSIBLE PROBLEM	SOLUTION(S)
2	Relief cannot be adjusted to maximum system pressure (high fluid bypass results in low system pressure	Debris on valve seat
		Valve spring is broken
		Valve spring has lost spring force due to continuous tension

PROCEDURE:

a. Isolate your tong from hydraulic power, and depressurize following the procedure in section 3.D

b. Loosen the locking nut on the pressure relief valve.

c. Use a large flat-head screwdriver to completely un-thread the poppet and spring from the relief assembly.

d. Inspect the relief valve spring, poppet, and valve seat.

e. If no debris is found in relief valve and if seat and poppet are undamaged, replace relief valve spring.

f. Reassemble relief valve.

g. Relief valve must be re-set to allow maximum system pressure. Follow the procedure in Step 1 of this section to properly adjust relief valve.

h. If maximum system pressure still cannot be reached, replace the entire relief valve assembly.

C. SAFETY DOOR DOES NOT OPERATE OR IS MALFUNCTIONING

	POSSIBLE PROBLEM	SOLUTION(S)
1	Safety door switch requires adjustment.	Adjust switch as per section 3.F.5
2	Safety door switch has failed	Test safety door switch for proper function and replace if necessary
3	Contamination in hydraulic lines	Ensure all three flexible hydraulic lines to safety door switch are free-flowing
4	Pilot-to-open valve in safety door valve block is malfunctioning.	Remove each valve. Inspect seats and springs. Replace valve(s) if damage is seen on valve seats, or if spring appears to be damaged or broken.

D. TONG RUNNING TOO SLOWLY

	POSSIBLE PROBLEM	SOLUTION(S)
1	Obstruction in tong hydraulic circuit preventing adequate flow	Inspect self-sealing couplings to ensure they are properly engaged
		The main hydraulic lines (supply and discharge) to the tong are obstructed. Remove and clean if required
2	Power unit is not producing adequate flow or pressure	Troubleshoot power unit (see user's manual for your particular unit)
3	Tong motor is excessively worn and is leaking hydraulic fluid past the vanes	Replace motor, or rebuild as per Section 7 of this manual
4	Bearings in gear train and rotary section are excessively worn	Overhaul tong. See Section 3 of this manual for tong overhaul procedures
5	Shifter has malfunctioned and the tong is not shifting to high gear	Inspect and repair shift mechanism as necessary
6	Hydraulic fluid viscosity too high	Ensure hydraulic fluid meets McCoy Drilling & Completions specifications
		Ensure hydraulic fluid is appropriate for climatic conditions, especially during cold-weather operation
7	By-pass valve not functioning	Check and repair

E. FAILURE OF JAWS TO GRIP PIPE

	POSSIBLE PROBLEM	SOLUTION(S)
1	Dies have become too dull to provide adequate grip	Replace dies
2	Incorrect jaws are being used	Double-check jaw size to ensure they are rated for the diameter of pipe or casing being run
3	Incorrect dies are being used	Ensure dies loaded in the jaws are appropriate for the type of pipe or casing being run
4	Brake band(s) is (are) insufficiently adjusted, not allowing jaws to cam properly	Adjust brake bands to give proper resistance to cage plates
5	Jaw roller broken or worn	Remove jaw assembly and inspect. Replace rollers that are visibly "flat-spotted" or otherwise damaged

F. FAILURE OR DIFFICULTY OF TONG TO SHIFT

	POSSIBLE PROBLEM	SOLUTION(S)
1	Bent or broken shifter handle	Replace shifter handle
2	"Frozen" or hard-to-move shifter handle	Grease shifter shaft
3	Bent or broken shifter yoke	Inspect components through inspection door. Replace shifter yoke if necessary.
4	Bent or broken shifter shaft	Replace
5	Locking nuts on shifting shaft have loosened and position of yoke has changed	Reposition yoke and re-tighten locking nuts
6	Shifting yoke has come loose from shifting shaft	Inspect yoke and inspect for damage. If free of damage, replace on shaft and tighten locking nuts
7	Tong pops out of gear	Ensure that detent ball & spring assembly has been correctly set

G. GENERAL COMMENTS

The following factors generally contribute to poor hydraulic operation and premature wear of equipment:

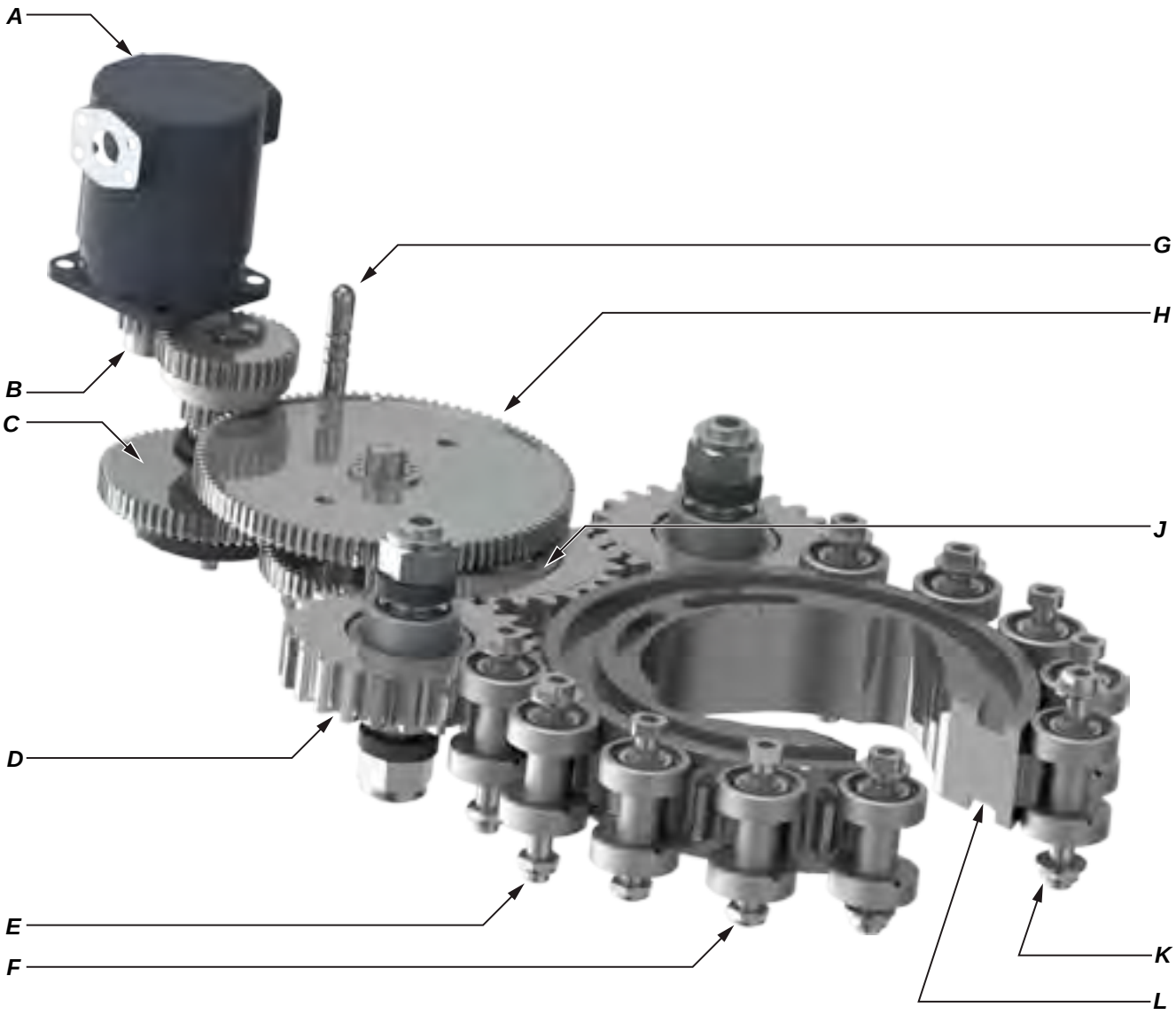
1. *Contaminated hydraulic fluid due to overuse, overheating, or inadequate fluid filtration.*
2. *Unsuitable hydraulic fluid, especially in extreme climatic conditions.*
3. *Defective packing or seals in components of the hydraulic system.*
4. *Poor or incomplete hydraulic system training. Users must be fully qualified to operate the equipment, and have complete understanding of the hydraulic system.*

If your hydraulic troubleshooting procedures involve flow and pressure tests at the power unit, McCoy Completions & Drilling recommends construction of a test rig that can easily be connected to the main suction and discharge ports of the power unit.

PARTS AND ASSEMBLIES

Model 80-0422 Shown

Model 80-0421-3 Shown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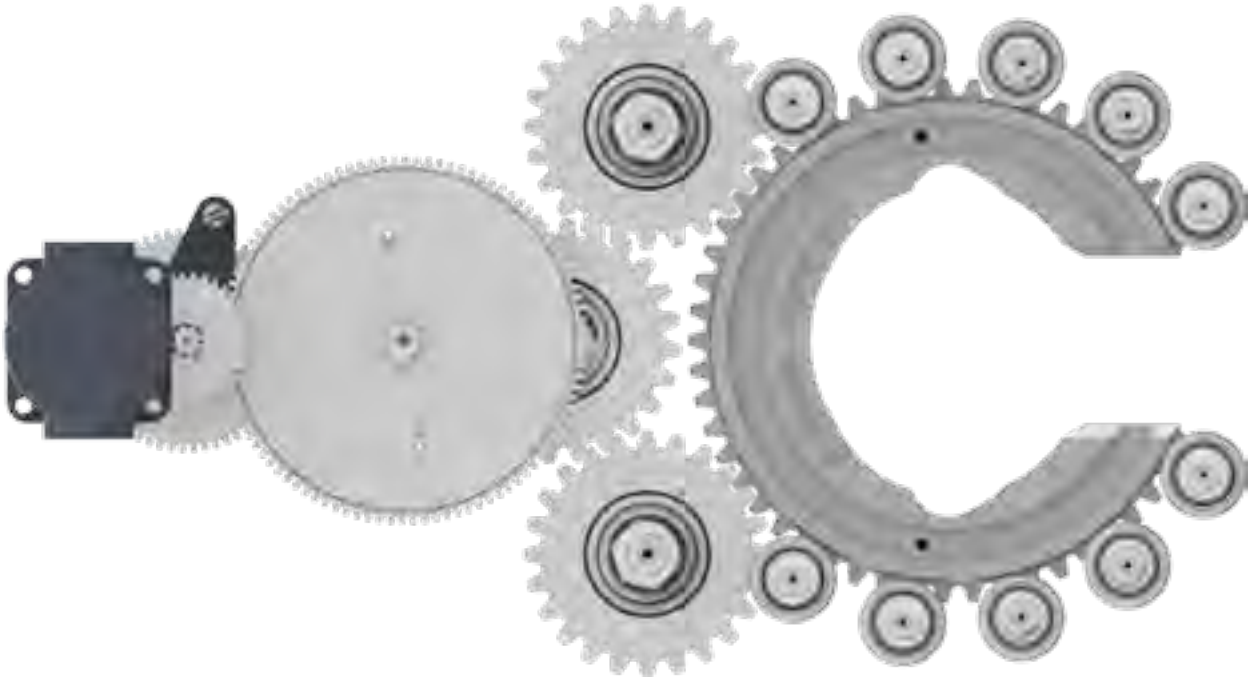
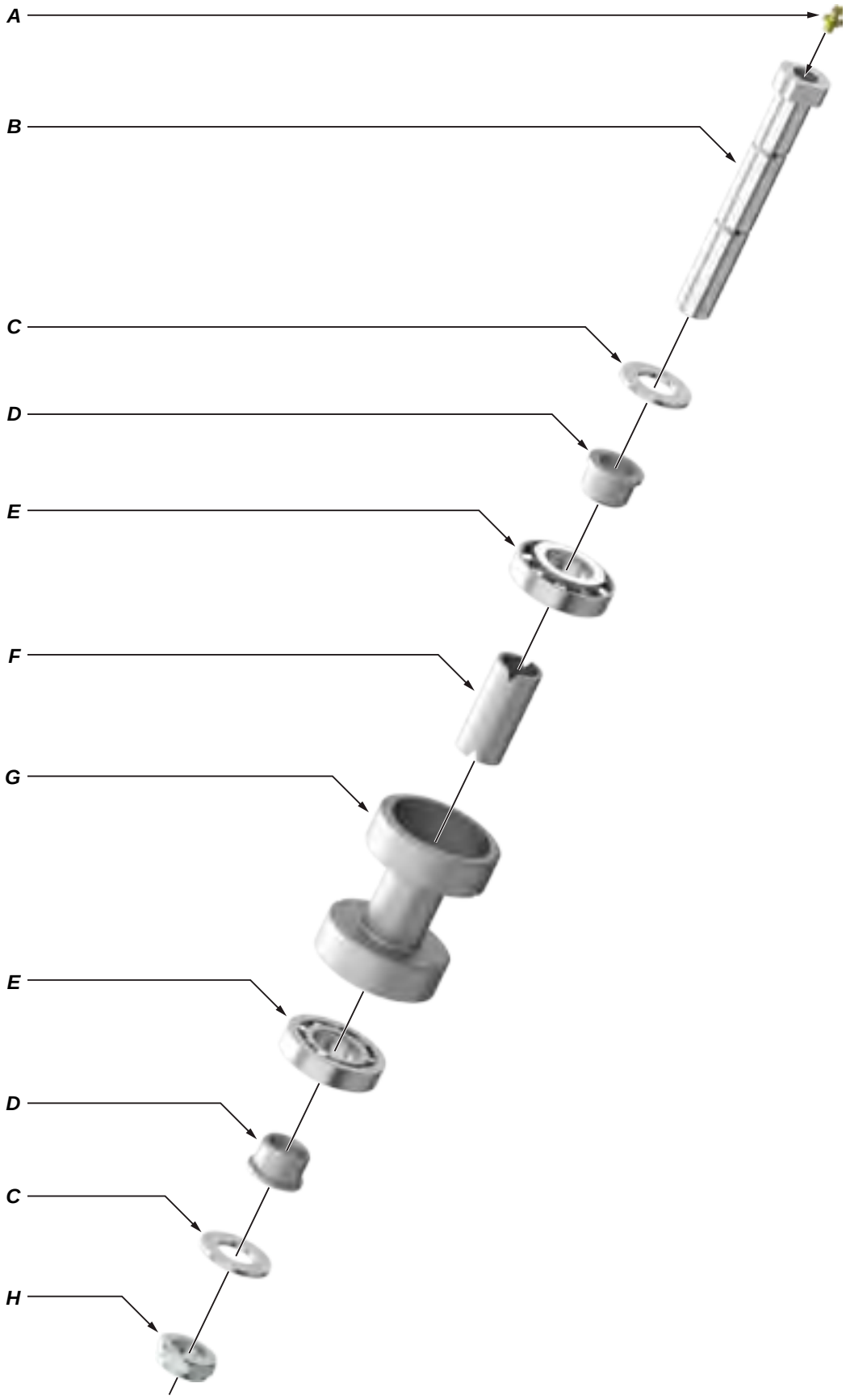


Item	Type	Description	Qty	Part Number
A	Part	Hydraulic Motor	1	87-0110
B	Part	Motor Gear	1	997-A10-149
C	Assembly	Clutch Assembly (Pp. 5.14 - 5.15)	1	
D	Assembly	Rotary Idler Assembly (Pp. 5.8 - 5.9)	2	
E	Assembly	Support Roller, Extended Shaft For Front Leg Mount (Pp. 5.4 - 5.5)	4	
F	Assembly	Support Roller, Extended Shaft For Front Leg Mount (Pp. 5.4 - 5.5)	5	
G	Assembly	Shifter Shaft Assembly (Pp. 5.16 - 5.17)	1	
H	Assembly	Pinion Assembly (Pp. 5.12 - 5.13)	1	
J	Assembly	Pinion Idler Assembly (Pp. 5.10 - 5.11)	1	
K	Assembly	Door Pivot Support Roller (Pp. 5.6 - 5.7)	1	
L	Part	Rotary Gear	1	1064-D1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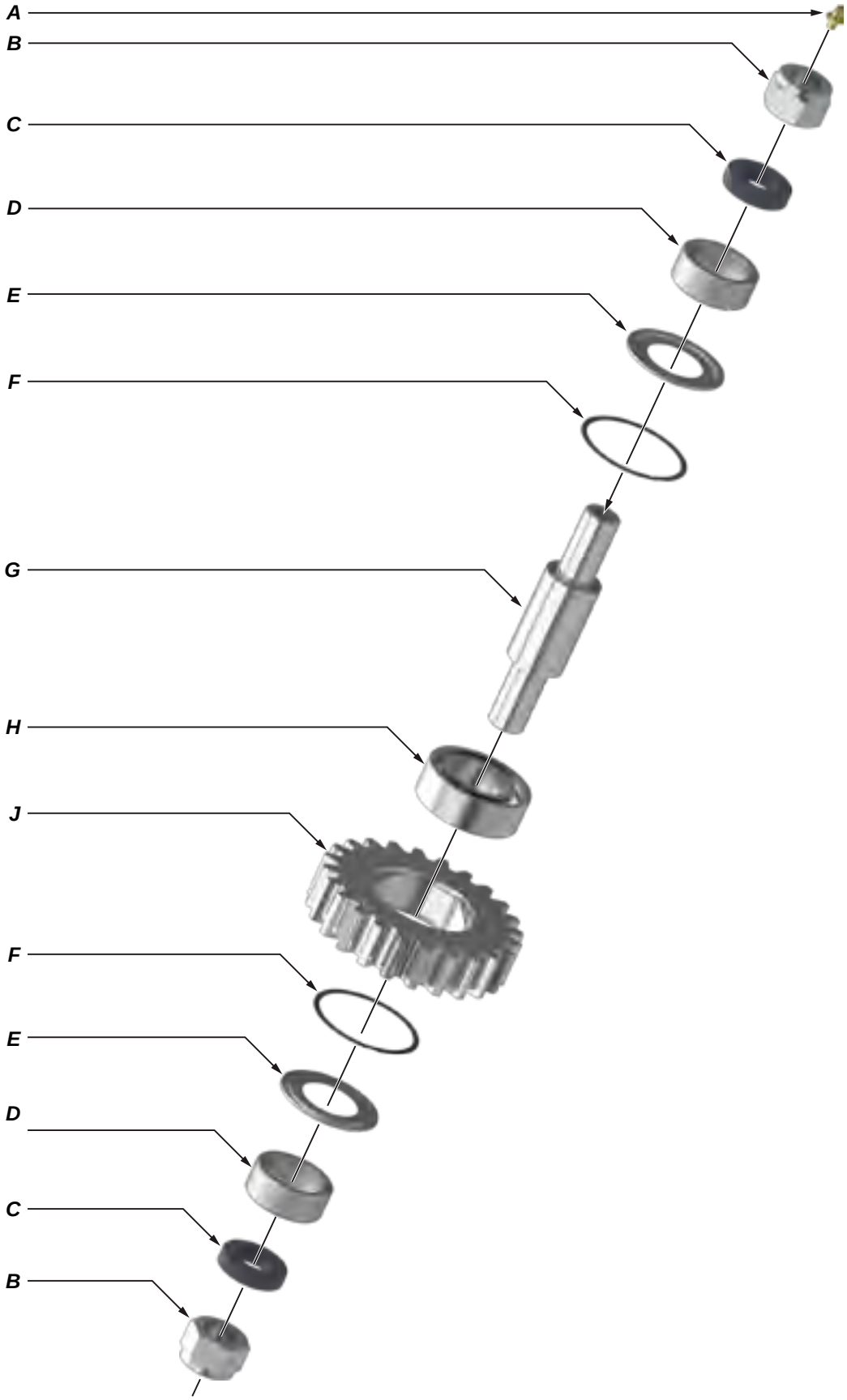
Item	Type	Description	Qty	Part Number
A	Part	1/4" UNF Straight Grease Fitting	1	02-0097
B	Part	Support Roller Shaft (1)	1	101-3942
	Part	Support Roller Shaft (Backup Ready Tongs Only)	1	101-3943
	Part	Door Pivot Roller Shaft	1	101-3944
C	Part	7/8" Narrow Flat Washer (2)	2	09-5123
D	Part	Support Roller Sleeve	2	1064-182
E	Part	Tapered Roller Bearing	2	02-0099
F	Part	Support Roller Shaft Spacer	1	1064-183
G	Part	Support Roller	1	1064-181
H	Part	7/8" UNF Hex Thin Nylock Nut	1	09-5722

(1) *"Backup-ready" tongs use 5x support roller shaft PN 101-3942. Use four "long" support roller shafts (PN 101-3944) where coincidental with the front leg mount weldments. The door pivot shaft remains PN 101-3943.*

(2) *Top and bottom flat washers are not used where the support roller shaft is coincidental with the brake band lug weldments. Bottom flat washers are not used where the support roller shaft is coincidental with the front leg mount weldments.*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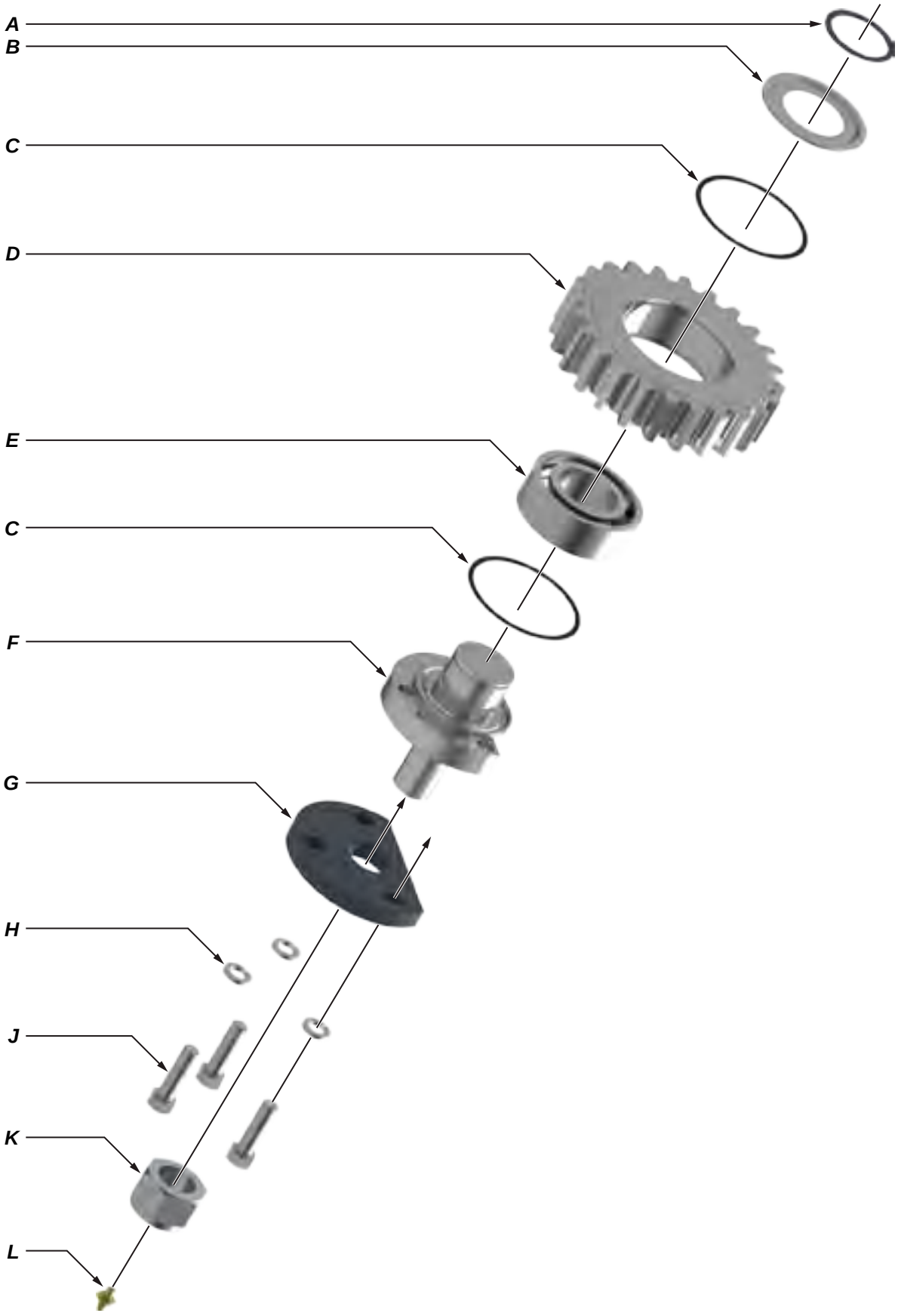
Item	Type	Description	Qty	Part Number
A	Part	Grease Fitting, 1/8" NPT	1	02-0005
B	Part	1-1/2" UNF Nylock Nut	2	09-5740
C	Part	Rotary Idler Pad	2	997-D20-125
D	Part	Idler Bearing Spacer	2	997-D20-121
E	Part	Bearing Seal	2	02-0010
F	Part	Bearing Retainer Ring	2	02-0009
G	Part	Idler Shaft	1	997-D19-117
H	Part	Idler Bearing	1	02-0011
J	Part	Idler Gear	1	997-A2-119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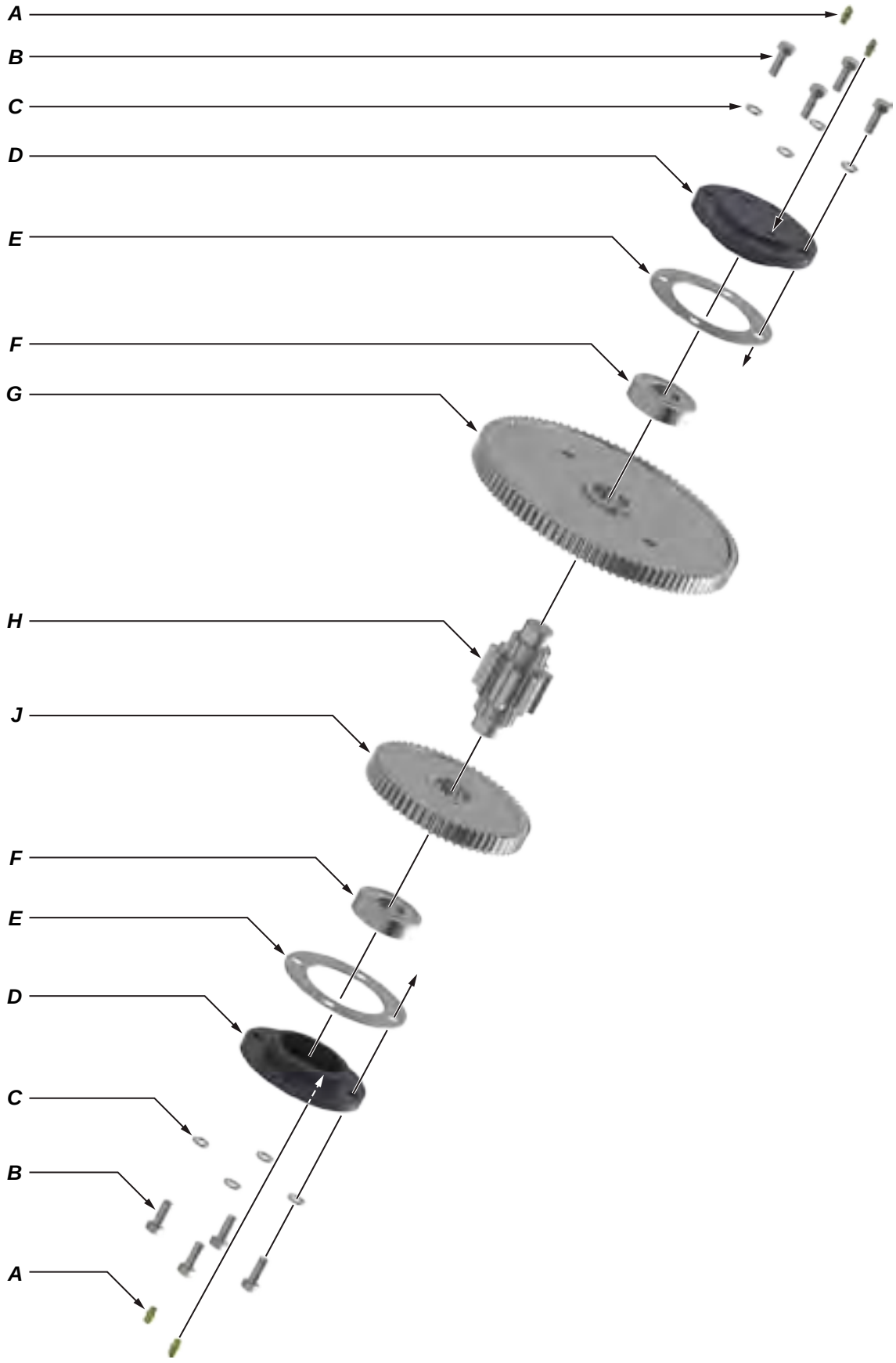
Item	Type	Description	Qty	Part Number
A	Part	Idler Bearing Retainer	1	02-0008
B	Part	Bearing Seal	1	02-0010
C	Part	Retainer Ring	2	02-0009
D	Part	Idler Gear	1	997-A2-119
E	Part	Idler Bearing	1	02-0011
F	Part	Idler Half Shaft	1	997-D17-105
G	Part	Pinion Idler Pad	1	1400-109
H	Part	5/8" Carbon Steel Lock Washer	3	09-5114
J	Part	5/8" UNC x 2-1/4" Hex Bolt	3	09-1235
K	Part	1-1/2" UNF Nylock Nut	1	09-5740
L	Part	Grease Fitting, 1/8" NPT	1	02-0005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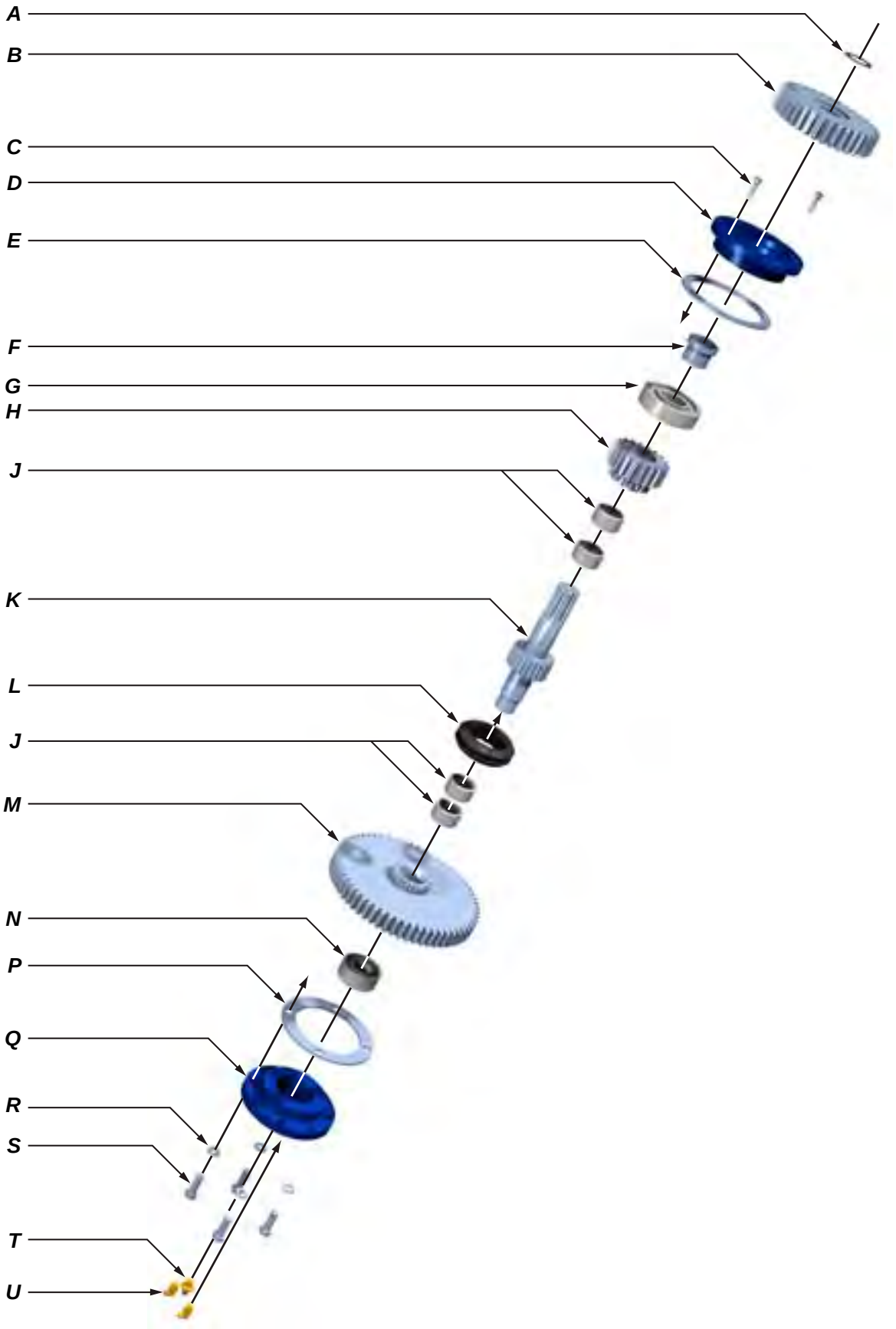
Item	Type	Description	Qty	Part Number
A	Part	Grease Fitting, 1/8" NPT x 90 Degree	4	02-0093
B	Part	1/2" UNC x 1-1/4" Hex Bolt	8	09-1168
C	Part	1/2" Lock Washer	8	09-5110
D	Part	Pinion Bearing Cap	2	997-D15-89
E	Part	Pinion Bearing Spacer	2	1400-89A
F	Part	Pinion Idler Bearing	2	02-0007
G	Part	Low Pinion Gear	1	997-A5-88
H	Part	Pinion Gear	1	997-A7-86
J	Part	High Pinion Gear	1	997-A4-87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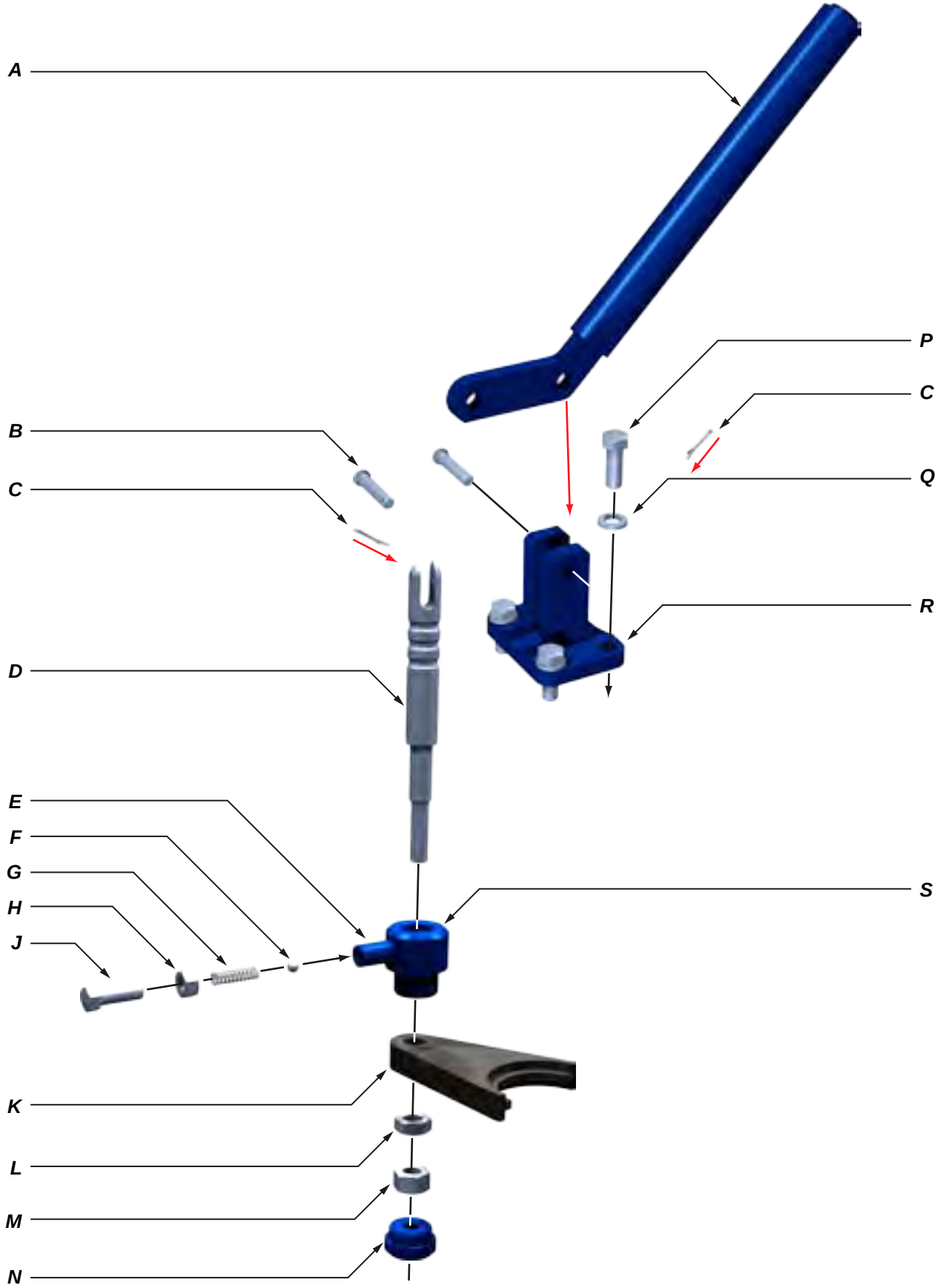
Item	Type	Description	Qty	Part Number
A	Part	Outside Snap Ring	1	02-0001
B	Part	Drive Shaft / Clutch Gear	1	997-A3-61
C	Part	#10-24 x 3/4" Hex Socket Head Cap Screw	2	09-0001
D	Part	Top Clutch Bearing Retainer	1	997-D11-59
E	Part	Top Clutch Bearing Retainer Spacer	1	1400-59A
F	Part	Clutch Bearing Bushing	1	997-60
G	Part	Top Clutch Bearing	1	02-0002
H	Part	Low Clutch Gear	1	997-A1-52
J	Part	Needle Bearing	4	02-0003
K	Part	Clutch Shaft	1	997-A8-50
L	Part	Shifting Collar	1	997-A9-62
M	Part	High Clutch Gear	1	997-A1-51
N	Part	Bottom Clutch Bearing	1	02-0004
P	Part	Clutch Bearing Cap Spacer	1	1400-54A
Q	Part	Clutch Bearing Cap	1	997-D11-54
R	Part	3/8" Carbon Steel Lock Washer	4	09-5106
S	Part	3/8" UNC x 1-1/4" Hex Bolt	4	09-1048
T	Part	Grease Fitting, 1/8" NPT	1	02-0005
U	Part	Grease Fitting, 1/8" NPT x 90 Degree	2	02-0093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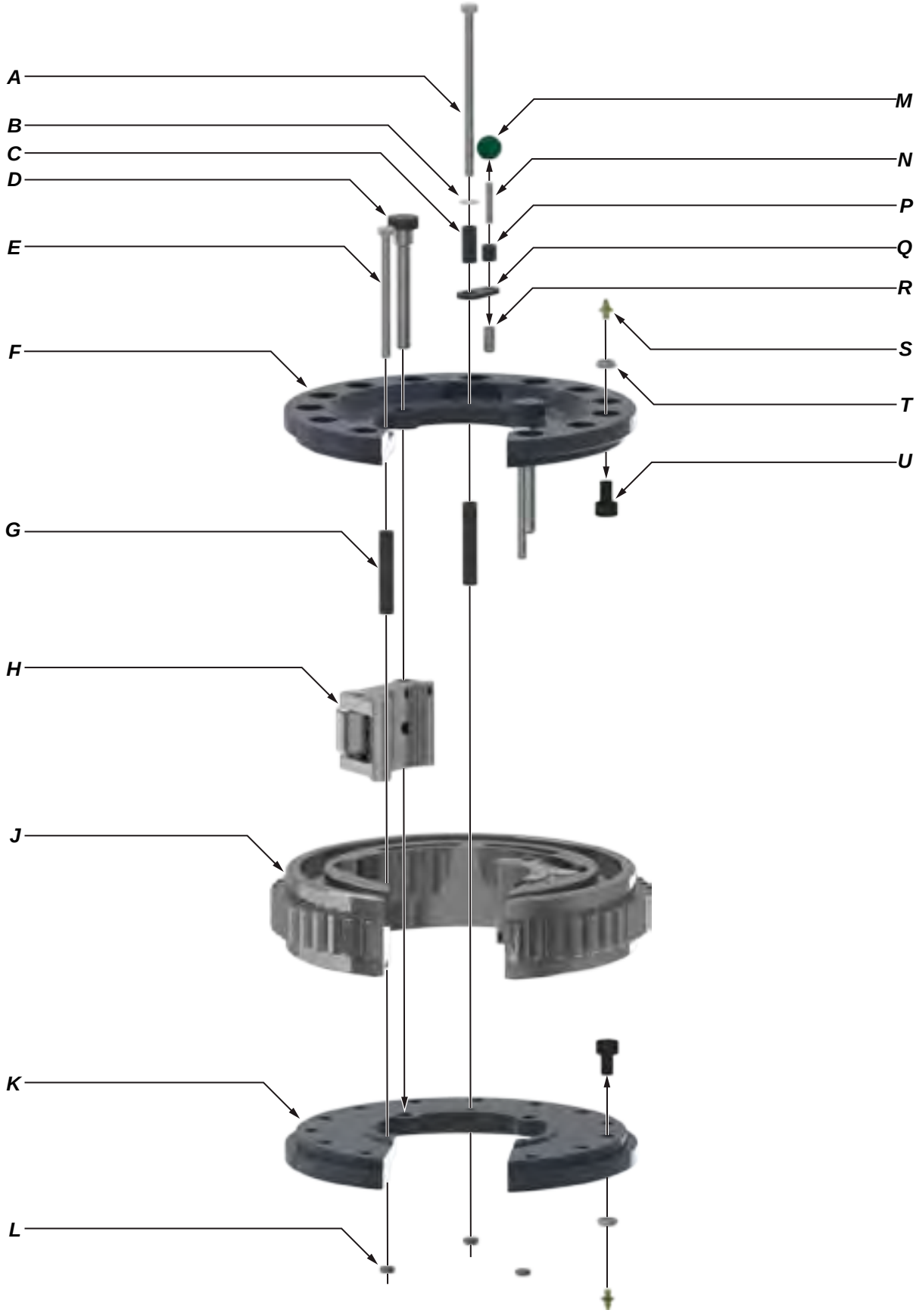
Item	Type	Description	Qty	Part Number
A	Weldment	Shifter Handle	1	1037-D-20B
B	Part	5/16" x 1-1/2" ANSI/ASME B18.8.1 Clevis Pin	2	09-0256
C	Part	BS 1574 5/64" x 5/8" Cotter Pin	2	
D	Part	Shifting Shaft	1	1400-71
E	Part	Shifter Detent Tube	1	101-0019
F	Part	Shifter Detent Ball	1	02-0018
G	Part	Shifter Detent Spring	1	997-0-64
H	Part	7/16" UNF Hex Nut	1	09-5908
J	Part	7/16" UNF x 1-1/4" Hex Bolt	1	09-1608
K	Part	Shifting Yoke	1	997-D13-72
L	Part	5/8" NF Hex Jam Nut	1	09-5915
M	Part	5/8" NF Hex Nut	1	09-5914
N	Part	Bottom Shifter Bushing (Typically welded to bottom plate)	1	1064-B1-95
P	Part	3/8" x 1" Hex Bolt	4	09-1170
Q	Part	3/8" Carbon Steel Lock Washer	4	09-5106
R	Weldment	Shifter Lug Weldment	1	101-0016
S	Part	Top Shifter Bushing (Threaded)	1	101-0020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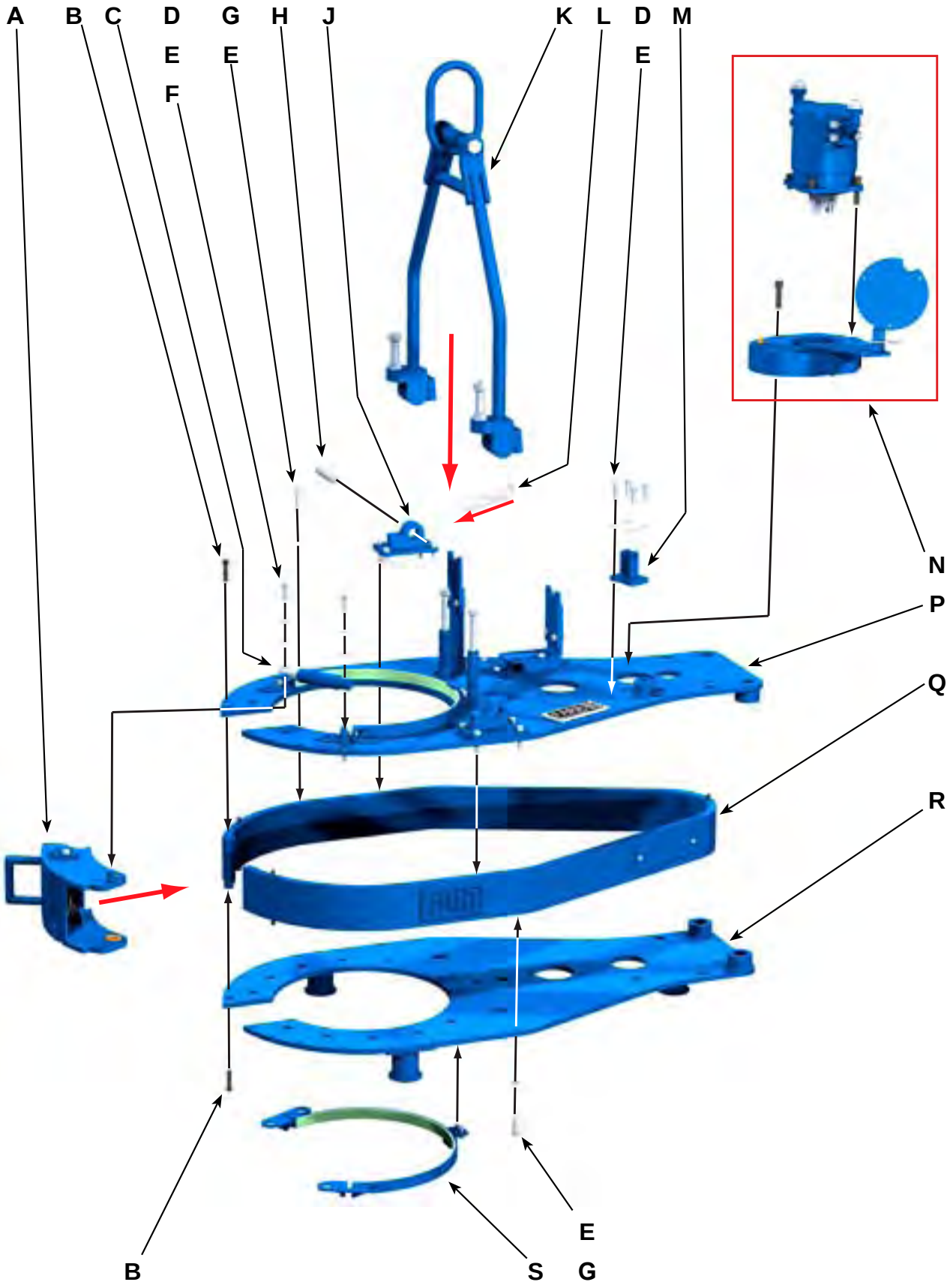
Item	Type	Description	Qty	Part Number
A	Part	1/2" UNC x 8" Hex Bolt	1	09-1198
B	Part	1/2" Narrow Flat Washer	1	09-5119
C	Part	Backing Pin Spacer	1	101-4093
D	Part	Jaw Pivot Bolt	2	1064-28
E	Part	1/2" NC x 6" Hex Bolt	2	09-1190
F	Part	Top Cage Plate	1	1400-21
G	Part	Cage Plate Spacer	3	1064-38
H	Assembly	Jaw Assembly (5-1/2" shown - see Pp. 2.12)	2	
J	Part	Rotary Gear	1	1064-D1
K	Part	Bottom Cage Plate	1	1400-22
L	Part	1/2" UNC Thin Nylock Nut	3	09-5610S
M	Part	Backing Pin Knob	1	02-0017
N	Part	3/8" UNC x 1-1/2" Threaded Dowel Pin	1	101-4097
P	Part	Backing Pin Spacer	1	101-4096
Q	Part	Backing Pin Retainer	1	101-4095
R	Part	Backing Pin	1	101-4094
S	Part	1/8" NPT Grease Fitting	26	02-0005
T	Part	5/8" UNF Thin Nylock Nut	26	09-5915
U	Part	Cam Follower	26	02-0016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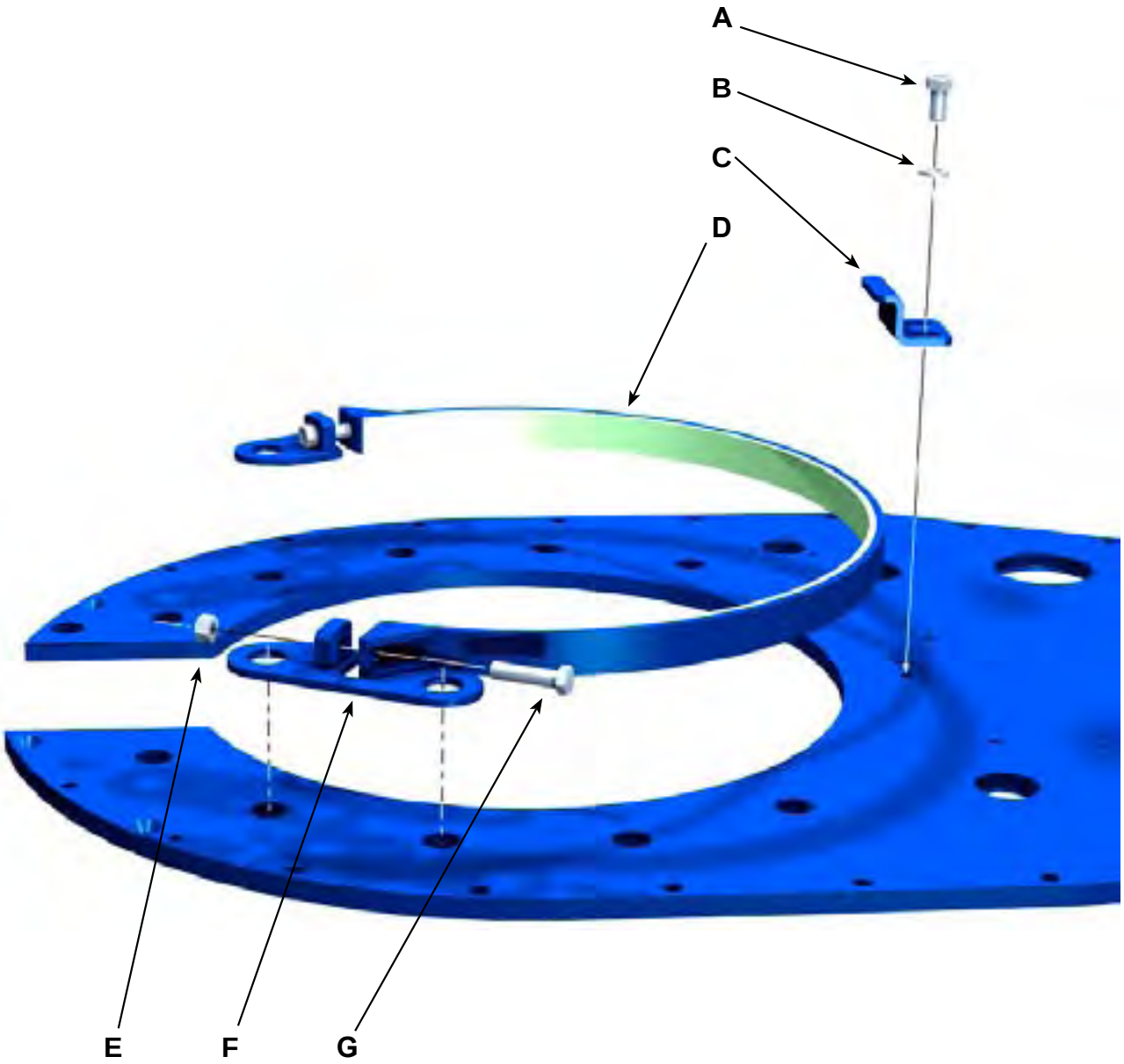
Item	Type	Description	Qty	Part Number
A	Assembly	Door Assembly (See Pp. 7.30 - 7.31)	1	
B	Part	3/8" NC x 1-3/4" Hex Socket Cap (Flat Head Height)	5	09-2052
C	Assembly	Door Cylinder Assembly	1	101-0069
D	Part	3/8" NC x 1-1/4" Hex Bolt	2	09-1048
E	Part	3/8" Carbon Steel Lockwasher	39	09-5106
F	Part	3/8" Narrow Flat Washer	2	09-5124
G	Part	3/8" NC x 1-1/2" Hex Bolt	29	09-1050
H	Part	Rigid Sling Pin	2	1053-C-1C
J	Weldment	Rigid Sling Bracket	2	101-0151
K	Assembly	Rigid Sling (See Pp. 7.32 - 7.33)	1	
L	Part	Hitch Pin, 1/4" x 5"	4	09-9075
M	Weldment	Shifter Lug Weldment	1	101-0016
N	Assembly	Motor & Motor Mount (See Pp. 7.26 - 7.27)	1	
P	Part	Top Plate	1	1400-7T
Q	Weldment	Side Body Weldment	1	101-0236
R	Part	Bottom Plate	1	1400-7B
S	Part	Brakeband Assembly (See Pp. 7.24 - 7.25)	2	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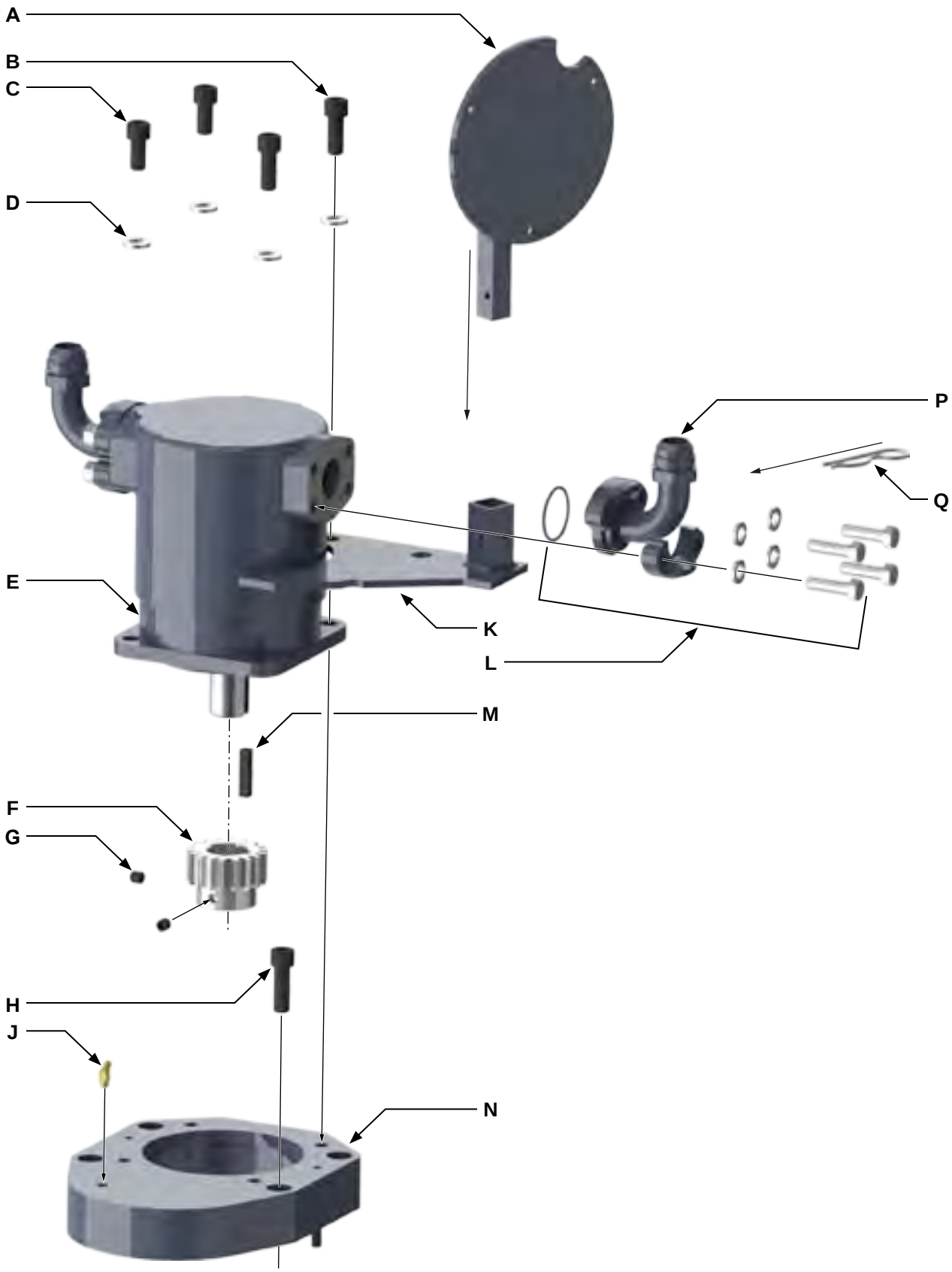
Item	Type	Description	Qty	Part Number
A	Part	3/8" NC x 3/4" Hex Bolt	2	09-1044
B	Part	3/8" Carbon Steel Lock Washer	2	09-5106
C	Part	Brake Band Retainer	1	101-0140
D	Assembly	Brake Band, Lined	1	1064-D4-29
E	Part	3/8" NF Hex Nut	2	09-5906
F	Weldment	LH Brake Band Lug Weldment	1	101-0134
	Weldment	RH Brake Band Lug Weldment	1	101-0132
G	Part	3/8" NF x 1-1/2" Brake Band Adjustment Bolt	2	09-1553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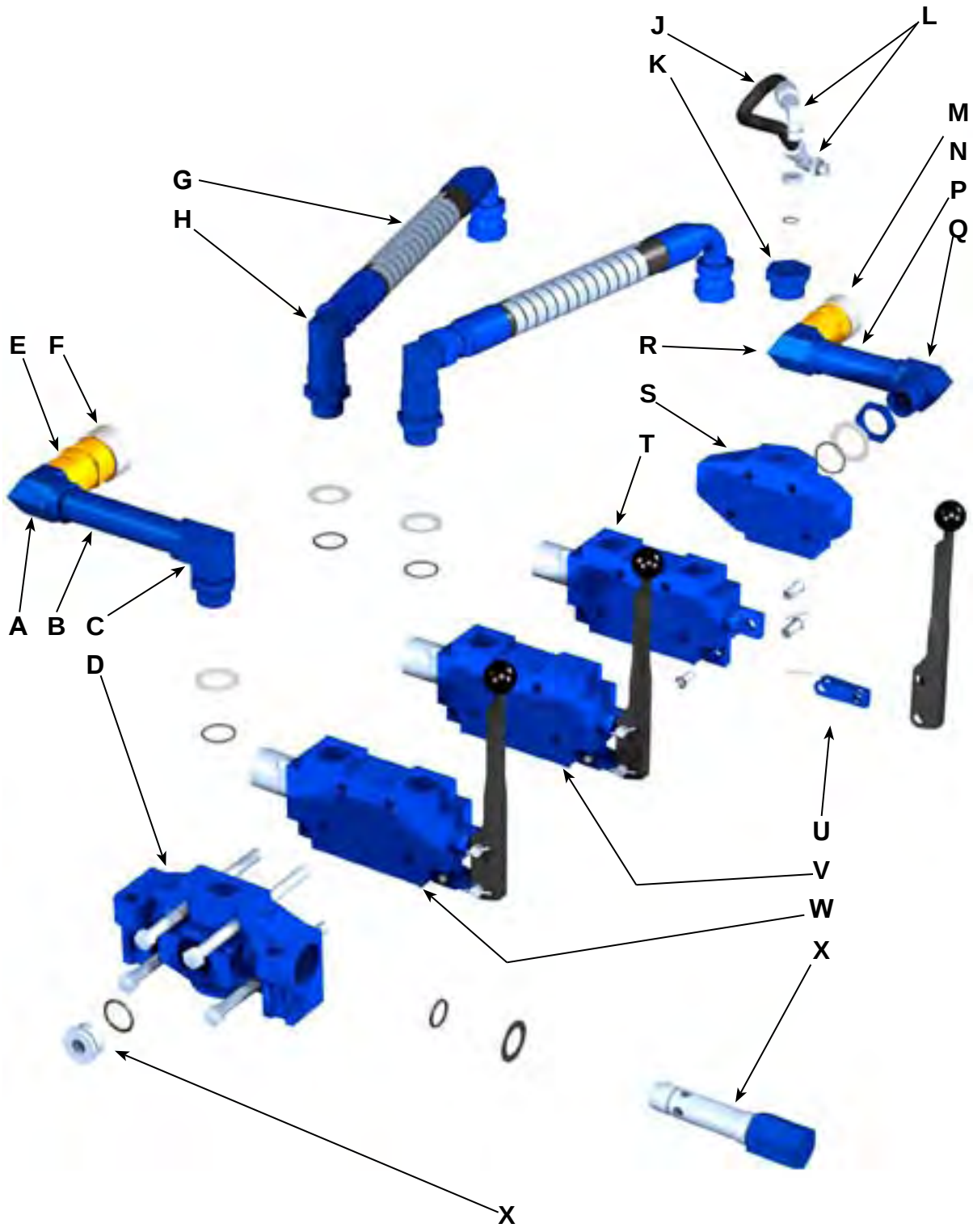
Item	Type	Description	Qty	Part Number
A	Weldment	Torque Gauge Mount Weldment	1	1500-09-03A
B	Part	1/2" NC x 1-1/4" Hex Socket Head Cap Screw	2	09-2168
C	Part	1/2" NC x 1" Hex Socket Head Cap Screw	2	09-2166
D	Part	1/2" Lock Washer	4	09-5110
E	Part	Rineer GA15-13 Hydraulic Motor	1	87-0110
	Part	Rineer GA15-13/6.5 Two-Speed Hydraulic Motor (Optional)	1	87-0007
F	Part	Motor Gear	1	997-A10-149
G	Part	3/8" NC x 3/8" Hex Socket Set Screw	2	09-0106
H	Part	1/2" NC x 1-1/2" Hex Socket Head Cap Screw	4	09-2170
J	Part	1/8" NPT 90 DEG Grease Fitting	1	02-0093
K	Weldment	Torque Gauge Holder Weldment	1	1500-09-04A
L	Part	#20 (1-1/4") Split Flange Kit	2	02-9217
	Part	O-Ring	1	
	Part	#20 (1-1/4") Split Flange	2	
	Part	7/16" Lock Washer	4	
	Part	7/16" NC x 1-1/2" Hex Bolt	4	
M	Part	Square 5/16" x 5/16" x 1-1/2" Key	1	01-0317
N	Part	Motor Mount	1	1400-150
P	Part	#20 (1-1/4")/JIC 1" Flange Elbow	2	02-9216
Q	Part	0.148 X 2.938 HITCH PIN	1	09-0090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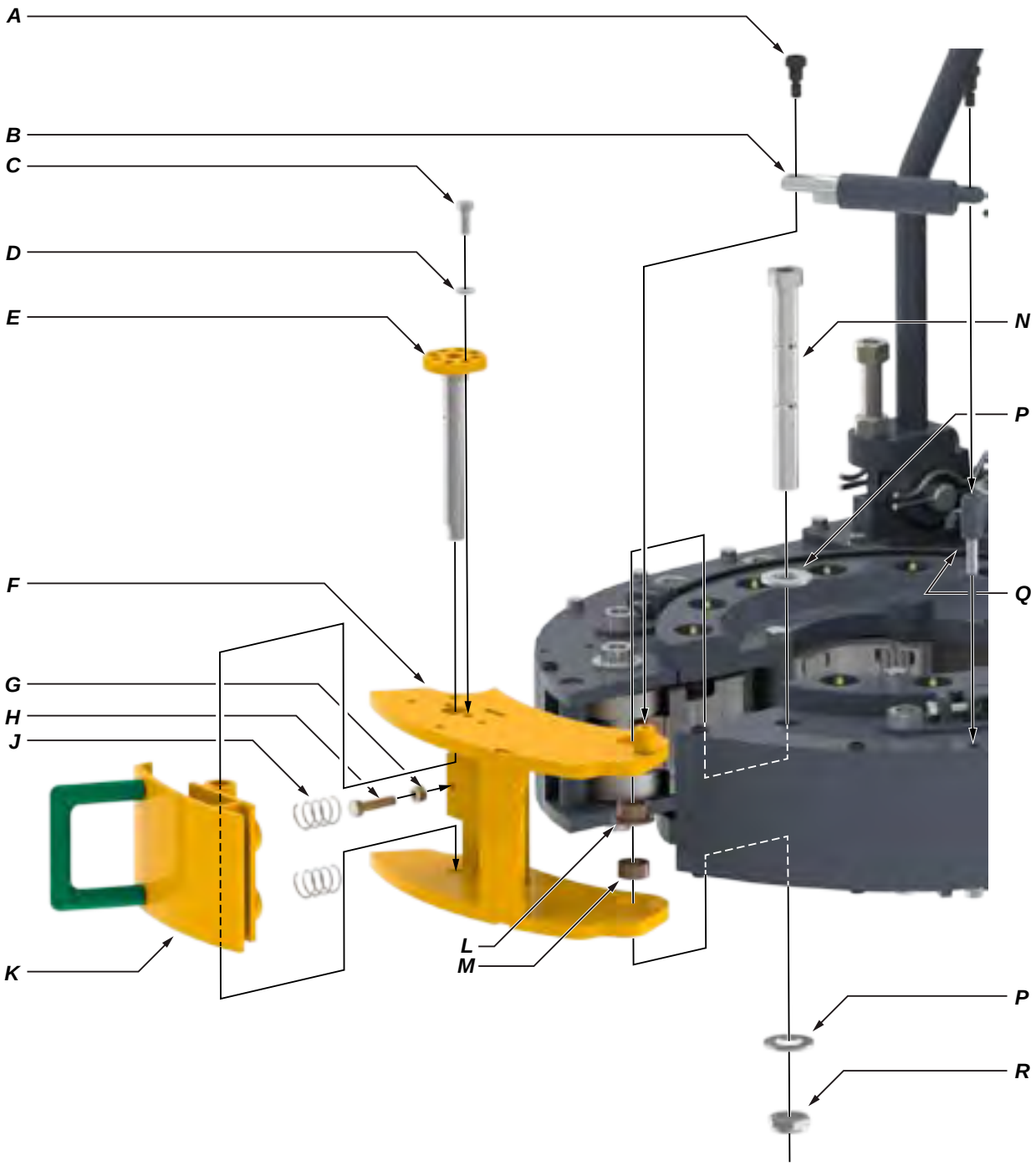
Item	Type	Description	Qty	Part Number
A	Part	M-NPT/F-NPT 90d 1" Fitting	1	02-9221
B	Part	1" Long Nipple	1	101-0079
C	Assembly	M-ORB/F-NPT 90d 1" Fitting (Includes seals)	1	02-9206
D	Part	Hydraulic Inlet, DVA35-A880	1	10-9016
E	Part	Male 1" Quick Coupler Fitting	1	02-9214
F	Part	1" Dust Cap	1	02-9213
G	Assembly	1" Hydraulic Connection Hose Assembly	2	08-1724
H	Assembly	M-ORB/JIC LONG 90d 1" (Includes seals)	1	02-9210
J	Assembly	Motor Drain Hose Assembly	1	101-0072
K	Part	ORB HEX BUSHING	1	10-9001
L	Assembly	M-ORB/JIC 90 DEG 3/8" Fitting (Includes seals)	2	02-9200
M	Part	1-1/4" Dust Cap	1	02-9212
N	Part	Male 1-1/4" Quick Coupler Fitting	1	02-9215
P	Part	1-1/4" Long Nipple	1	101-0070
Q	Assembly	M-ORB/F-NPT 90d 1 1/4" Fitting (Includes seals)	1	02-9202
R	Part	M-NPT/F-NPT 90d 1 1/4" Fitting	1	02-9220
S	Part	Hydraulic Outlet, DVA35-TR99	1	10-0086
T	Part	DVA35-DA8 4WAY SAE Ports	1	10-9019
U	Assembly	Handle Assembly	3	01-0409
	Part	Hydraulic Valve Handle	1	01-0409-HANDLE
	Part	Valve Handle Link	2	01-0409-LINK
	Part	Hydraulic Handle Pin	2	01-0409-PIN1
	Part	Hydraulic Handle Auxilliary Pin	1	01-0409-PIN2
	Part	Valve Handle C-Clip	2	01-0409-CIRCLIP
	Part	Cotter Pin	2	01-0409-COTTER
V	Part	DVA35-SA8 Valve (1" ORB PORT)	1	10-9015
W	Part	DVA35-MA8 4-Way Directional Valve, SAE Port	1	10-9014
X	Assembly	Hydraulic Relief Valve (includes seals)	1	10-0010R
Y	Part	1" Orb Plug Fitting (includes o-ring)	1	02-9222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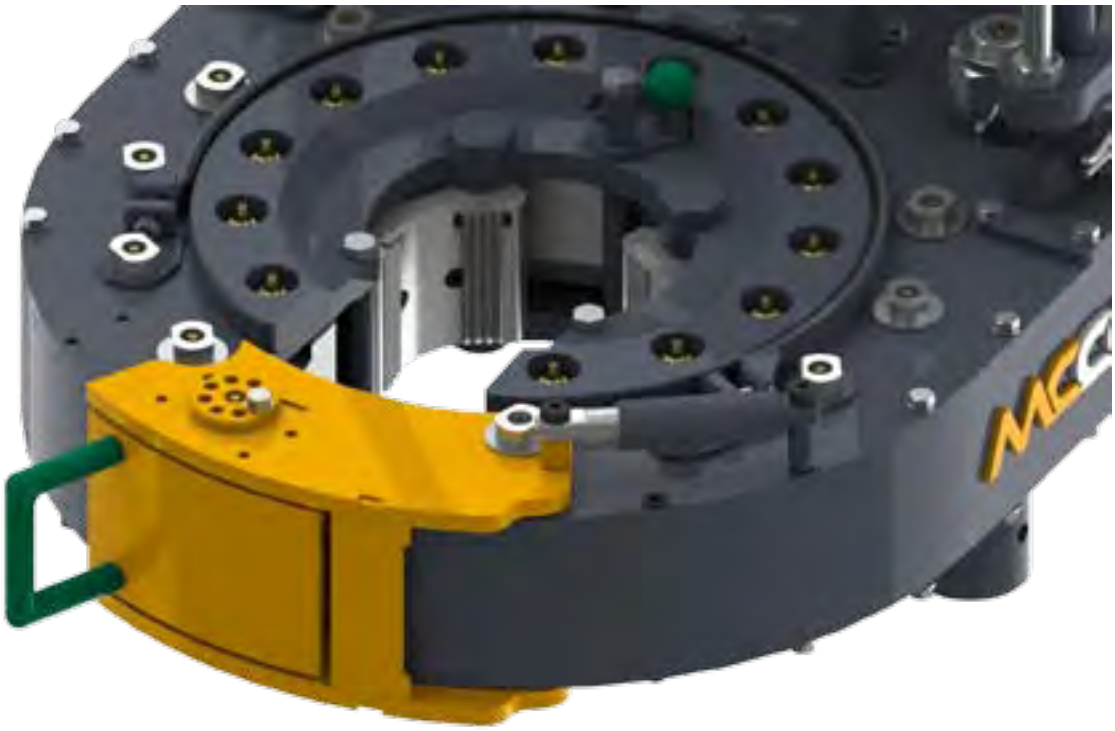
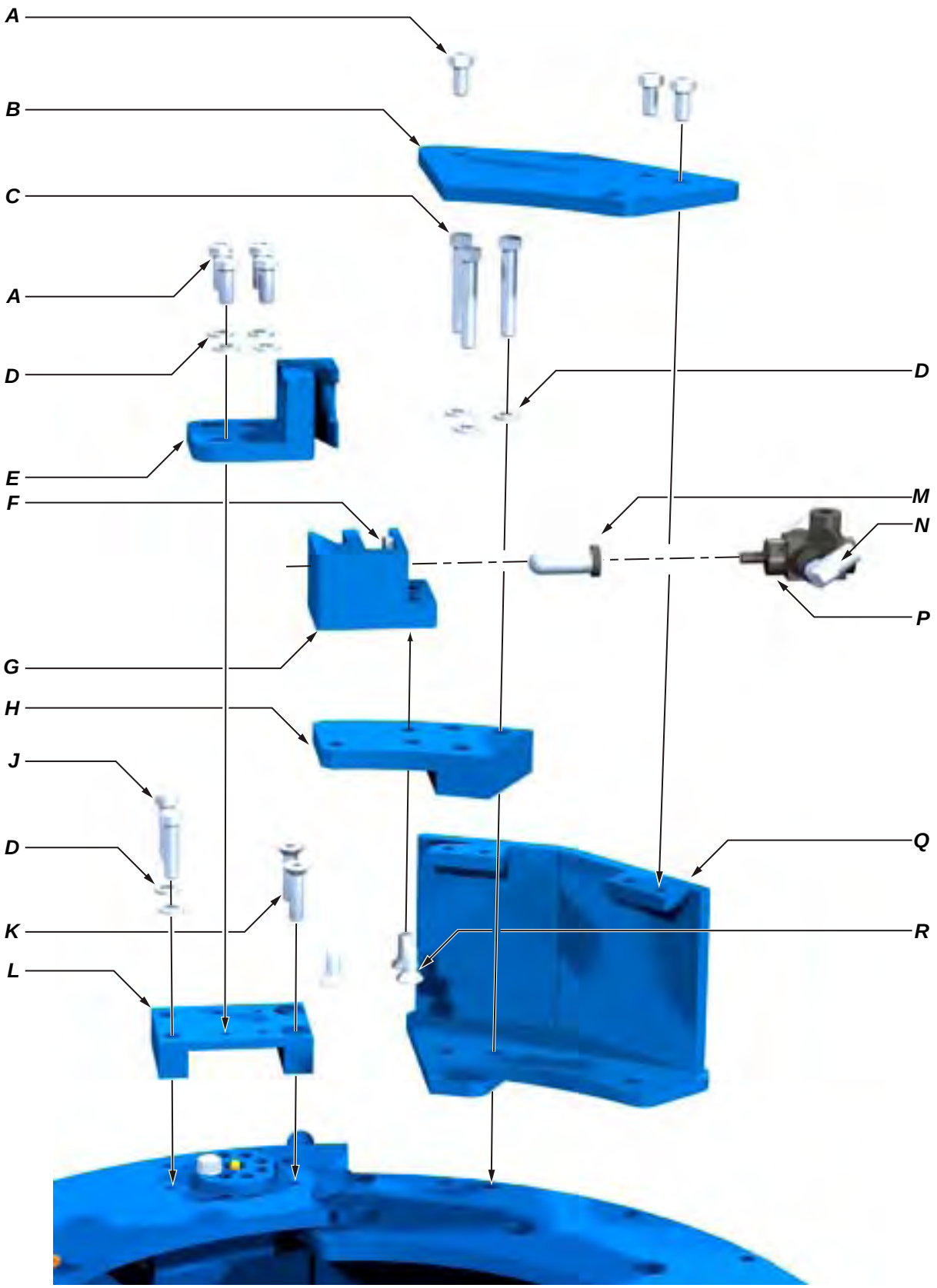


Item	Type	Description	Qty	Part Number
A	Part	5/16" x 3/4" UNC Shoulder Bolt	2	09-0227
B	Assembly	Door Cylinder	1	101-0069
C	Part	3/8" NC x 1" Hex Bolt	1	09-1046
D	Part	3/8" Carbon Steel Lock Washer	3	09-5106
E	Part	Adjustment Cam	1	1400-14
F	Weldment	Door Weldment	1	1400-10
G	Part	3/8" UNC Hex Nut	2	09-5806
H	Part	3/8" NC x 1-1/2" Hex Bolt	1	09-1553
J	Part	Latch Spring	2	997-16
K	Weldment	Door Latch Weldment	1	1064-C7-15
L	Part	Shoulder Bushing	1	101-5110
M	Part	Door Bushing (Bottom)	1	101-5111
N	Part	Door Pivot Roller	1	101-3943
P	Part	7/8" Narrow Flat Washer	2	09-5123
Q	Part	Door Cylinder Mounting Lug	1	1050-12-001
R	Part	7/8" UNF Thin Nylock Nut	1	09-5722
	Part	1/4" Straight Grease Fitting (Adjustment Cam - not shown)	1	02-0097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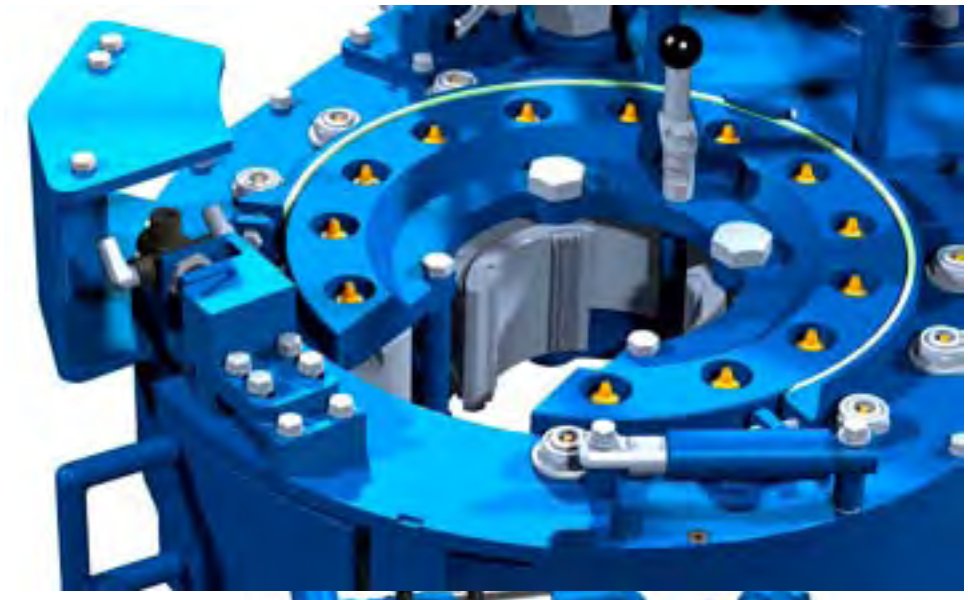
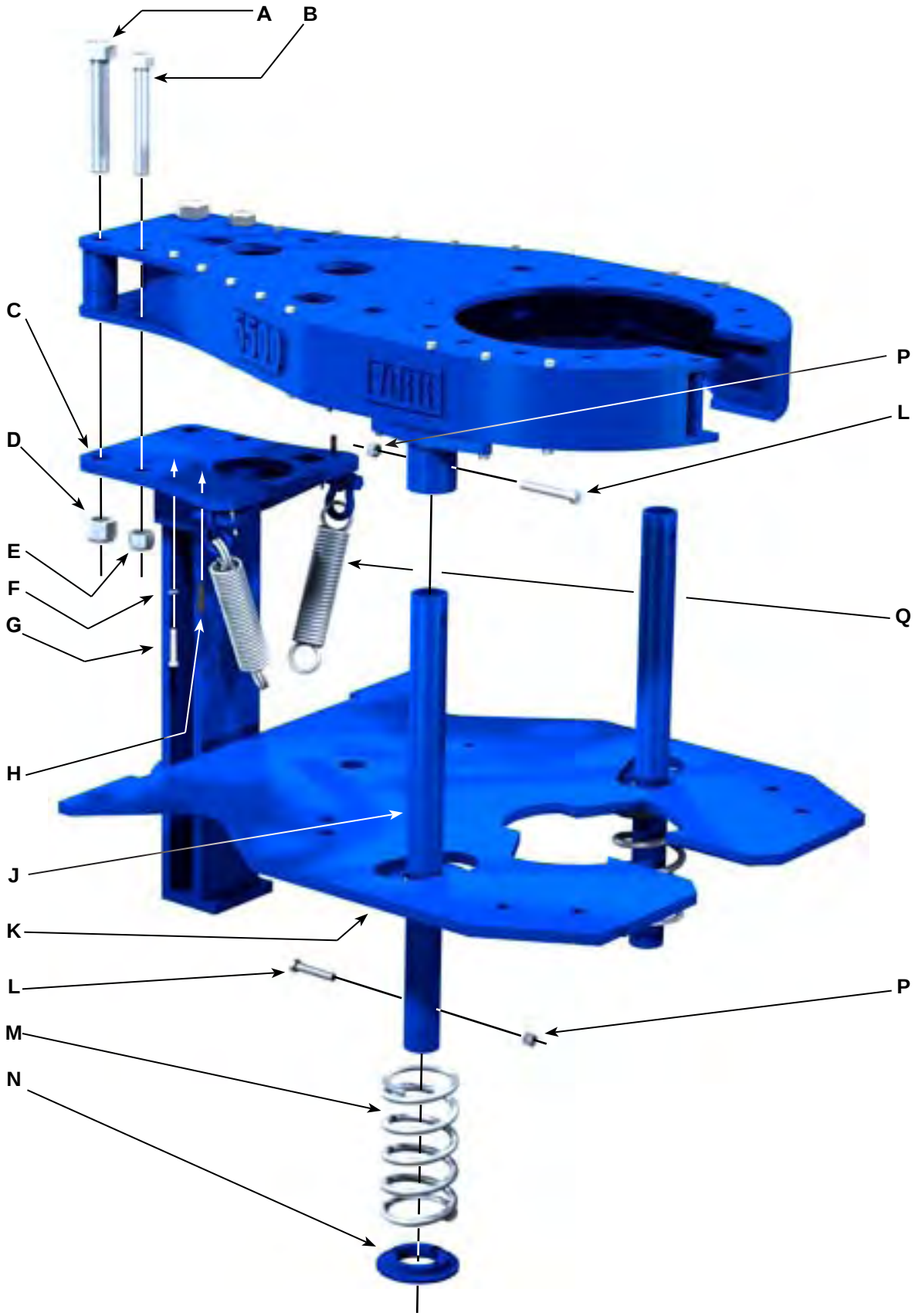


Item	Type	Description	Qty	Part Number
A	Part	3/8" NC x 3/4" Hex Bolt	4	09-1044
B	Part	Switch Guard Top Plate	1	101-1480
C	Part	3/8" NC x 2-1/4" Hex Bolt	3	09-1055
D	Part	3/8" Carbon Steel Lock Washer	9	09-5106
E	Part	Safety Door Latch Block	1	101-1104
F	Part	15/16" Valve Lock Nut	1	09-0278
G	Part	Safety Door Latch Block	1	101-1103
H	Part	Safety Door Latch Plate	1	101-1105
J	Part	3/8" NC x 1-1/2" Hex Bolt	2	09-1553
K	Part	3/8" NC x 1-1/2" Flat Head Countersunk Cap Screw	2	09-4050
L	Part	Safety Door Latch Block	1	101-0914
M	Part	Load Plunger	1	AE12-306
N	Part	1/4 inch NPT - JIC 90 degree elbow	3	08-0284
P	Part	Deltrol Gauge Isolator Valve G121S	1	08-0337M
Q	Weldment	Safety Door Switch Guard Weldment	1	101-1481
R	Part	3/8" NC x 7/8" Flat Head Countersunk Cap Screw	3	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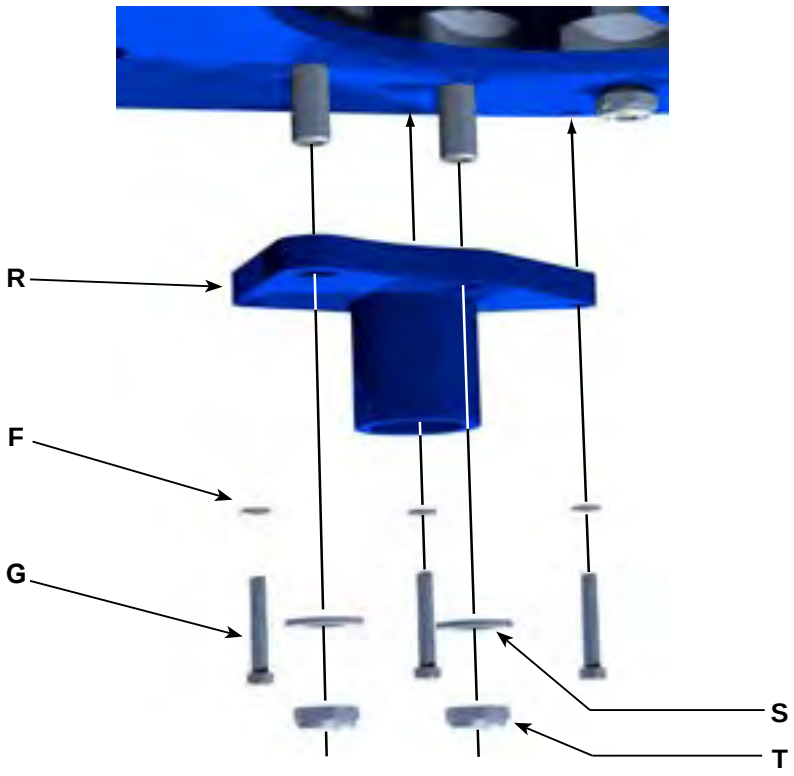
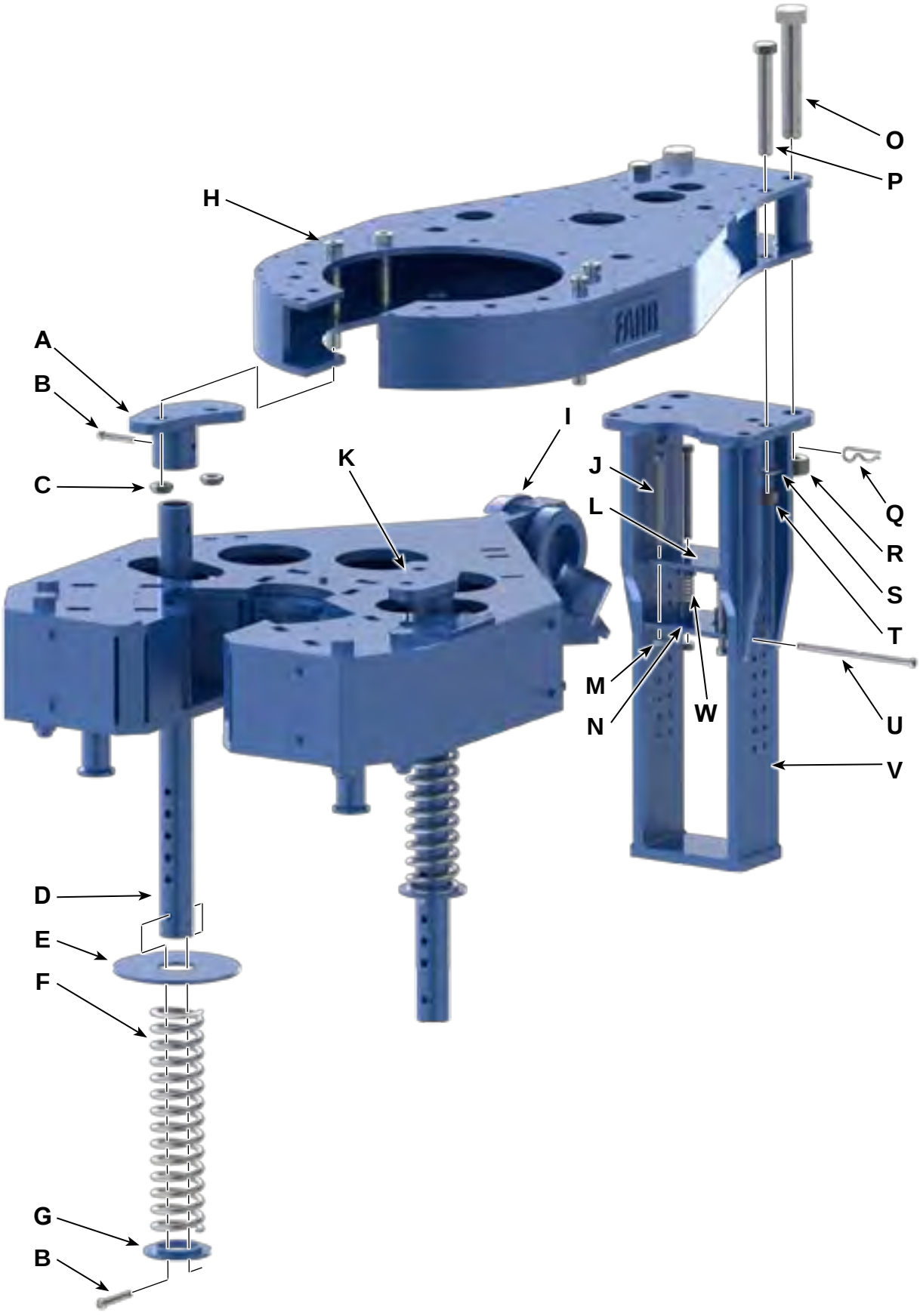


Item	Type	Description	Qty	Part Number
A	Part	1-1/4" NC x 8" Hex Bolt	2	09-0222
B	Part	1" NC x 7" Hex Bolt	2	09-9165
C	Weldment	Rear Leg Weldment - Tension Load Cell Configuration	1	1010-1987
	Weldment	Rear Leg Weldment - Compression Load Cell Configuration	1	1010-1547
D	Part	1-1/4" NC Hex Nylock Nut	2	09-1484
E	Part	1" NC Hex Nylock Nut	2	09-5725
F	Part	3/8" Carbon Steel Lockwasher (Leg-Body)	10	09-5106
G	Part	3/8" NC x 2-1/4" Hex Bolt (Leg-Body)	10	09-1055
H	Part	3/8" NC x 1-1/2" Hex SHCS (Rear Leg-Body)	2	09-2051
J	Part	Front Leg Tube	2	101-2155
K	Part	Top Spring Cap - Front Leg (Tension Load Cell Configuration)	2	1302-905-03B
	Part	Top Spring Cap - Front Leg (Compression Load Cell Configuration)	2	101-4489
L	Part	1/2" NC x 3" Hex Bolt	4	09-1178
M	Part	Front Leg Spring (Tension Load Cell Configuration)	2	1391-905-02B
		Front Leg Spring (Compression Load Cell Configuration)	2	1302-905-08
N	Part	Bottom Spring Cap - Front Leg	2	1302-905-03C
P	Part	1/2" NC Nylock Nut	4	09-5610
Q	Part	Rear Backup Suspension Spring (Tension Load Cell Configuration)	2	1391-905-03
	Part	Rear Backup Suspension Spring (Compression Load Cell Configuration)	2	1302-905-03A
R	Weldment	LH Front Leg Mount Weldment - Tension Load Cell Configuration	1	101-2152
	Weldment	RH Front Leg Mount Weldment - Tension Load Cell Configuration	1	101-2153
	Weldment	LH Front Leg Mount Weldment - Comp. Load Cell Configuration	1	101-0786
	Weldment	RH Front Leg Mount Weldment - Comp. Load Cell Configuration	1	101-0787
S	Part	7/8" Narrow Washer	2	09-5123
T	Part	7/8" NF Hex Thin Nylock Nut	2	09-5722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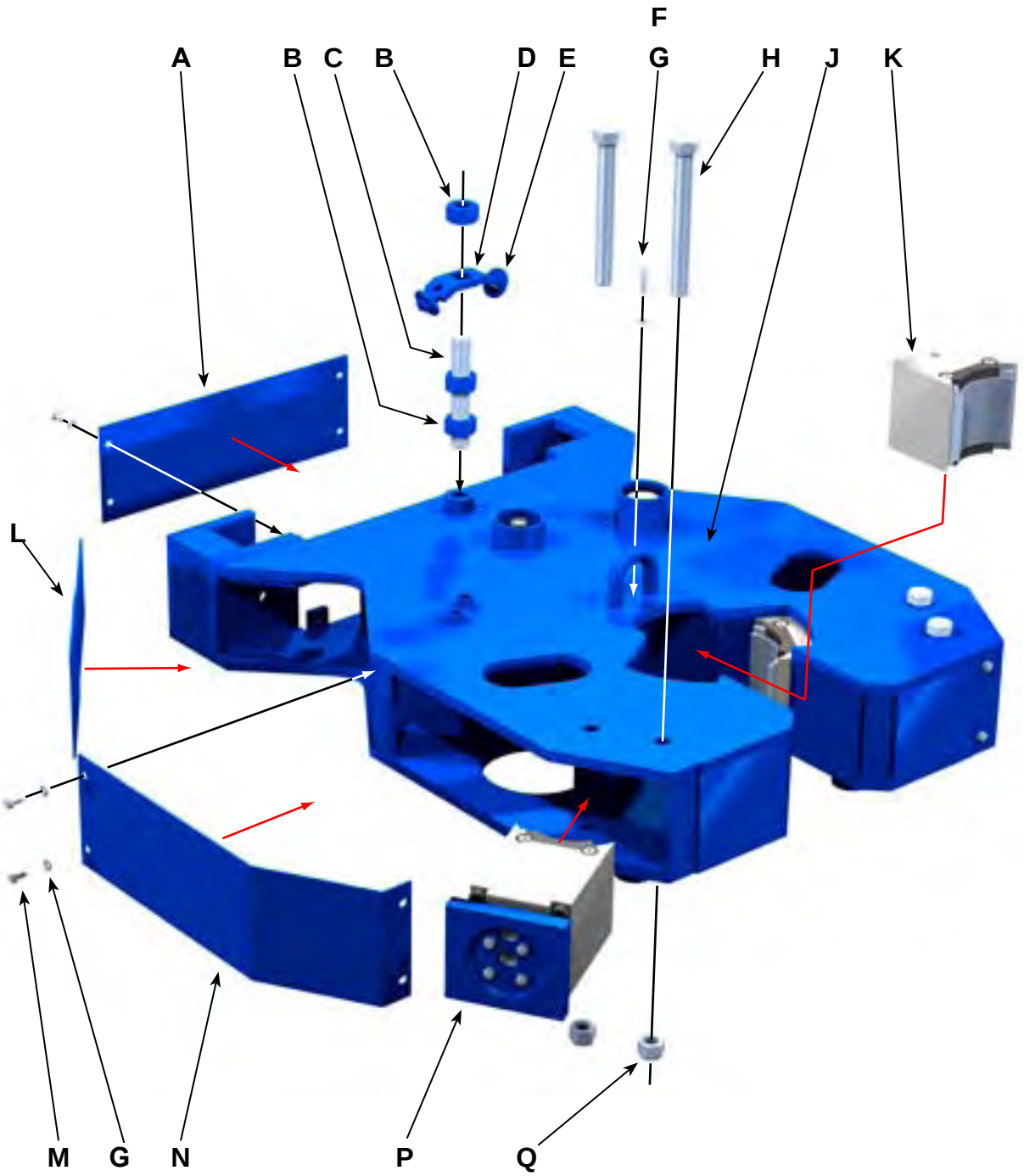
Item	Type	Description	Qty	Part Number
A	Weldment	LH Front Leg Mount	1	101-0787
B	Part	7/16" NC x 3 1/2" Hex Bolt	4	
C	Part	7/8" NF Thin Nylock Nut	4	09-5722
D	Part	Support Leg	2	1364-909
E	Part	Front Leg Spring Top Cap	2	101-4489
F	Part	Front Leg Spring	2	1302-905-08
G	Part	Bottom Leg Cap	2	1302-905-03A
H	Assembly	Support Roller Shaft	4	101-3944
I	Weldment	2" Load Cell Holder	1	01-9116D
J	Part	1/2" NC x 6" Hex Bolt	4	09-1190
K	Weldment	RH Front Leg Mount	1	101-0786
L	Weldment	Rear Backup Leg Spring Plate (Top)	1	101-4495
M	Part	1/2" Hex Nut	4	09-9124
N	Weldment	Rear Backup Leg Spring Plate (Bottom)	1	101-4496
O	Part	Heavy Hex Bolt	1	101-0040
P	Part	7/8" NC x 7" Hex Bolt	1	
Q	Part	0.148" x 2.938 Hitch Pin	2	
R	Part	1 1/4" Hex Nut	2	09-5832
S	Part	7/8" Narrow Plain Washer	2	09-5123
T	Part	7/8" Hex Nut	2	09-5822
U	Part	3/8" NC x 9" Hex Bolt	2	
V	Weldment	Rear Backup Leg	1	101-4487
W	Part	Door Stop Spring	2	997-13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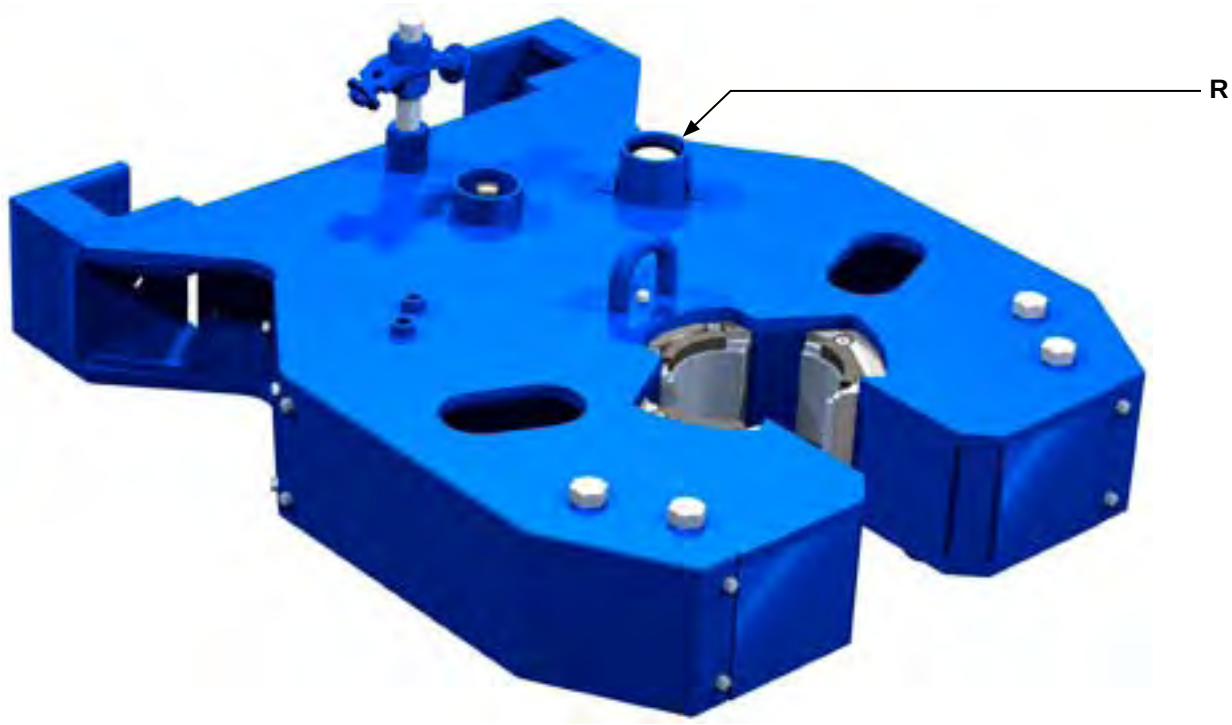
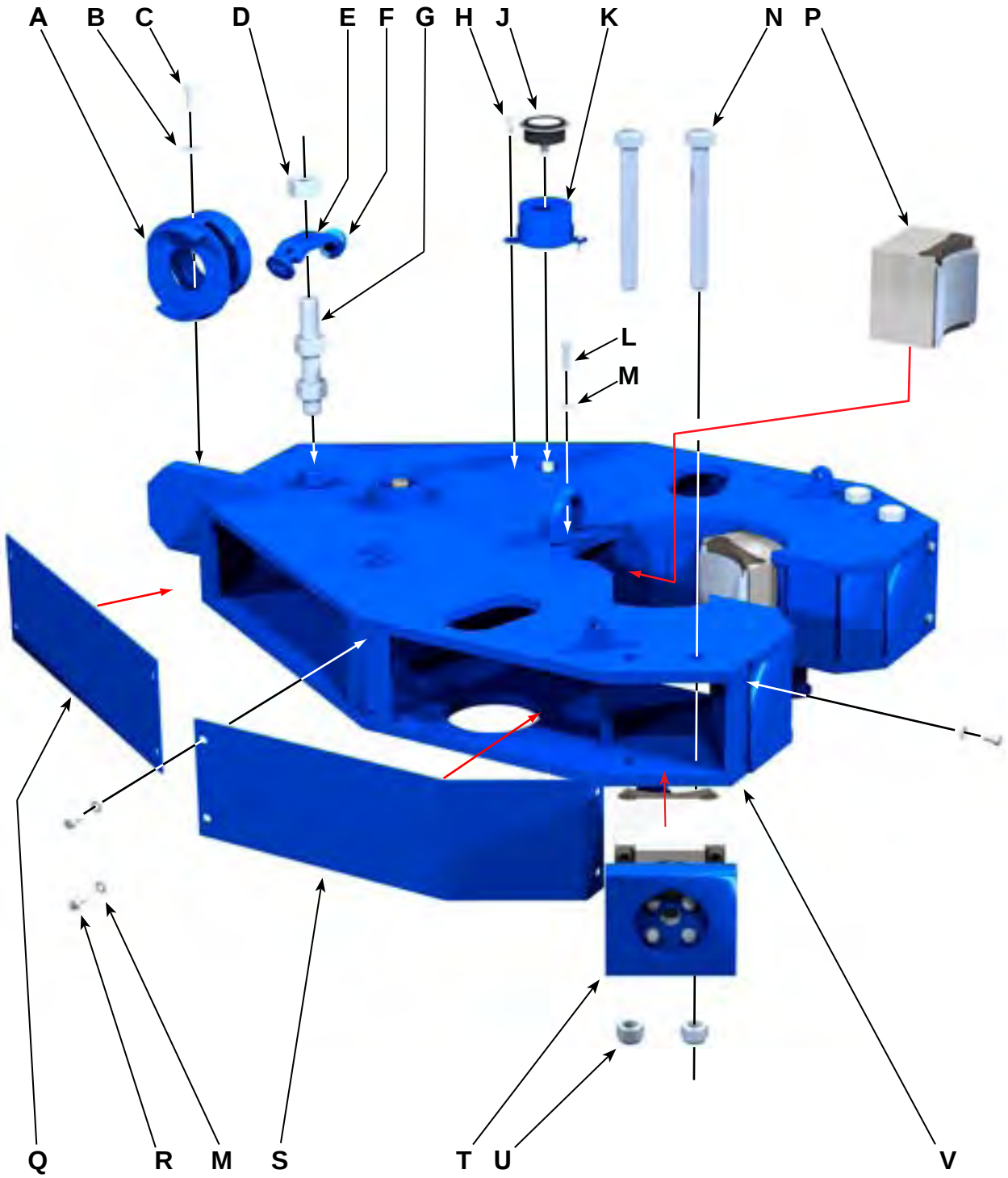


Item	Type	Description	Qty	Part Number
A	Part	Rear Body Plate	1	1391-7-3
B	Part	1-1/4" UNC Hex Nut	3	09-5832
C	Part	1-1/4" UNC x 8" Threaded Rod	1	101-1993
D	Part	Suspension Spring V-Bracket	1	1483-500-00-04
E	Part	Suspension Spring Retainer	2	1483-500-00-4B
F	Part	3/8" UNC x 1-1/2" Hex Bolt	1	09-1050
G	Part	3/8" Carbon Steel Lock Washer	21	09-5106
H	Part	1" UNC x 8-1/2" Hex Bolt	4	09-0287
J	Weldment	Backup Body Weldment	1	1483-500-00
K	Part	Rear Jaw	1	1403-08
L	Part	Rear-Side Cover Plate	2	1483-500-00-02
M	Part	3/8" UNC x 3/4" Hex Bolt	20	09-1044
N	Part	Side Cover Plate	2	1483-500-00-01
P	Assembly	**CLINCHER®** Cylinder Assembly	2	1403-00-00B
Q	Part	1" UNC Nylock Nut	4	09-5725
R	Weldment	Gauge Protector Weldment	1	1483-500-18
	Part	Relief Valve Body	1	08-1180
	Part	Relief Valve Cartridge	1	08-0481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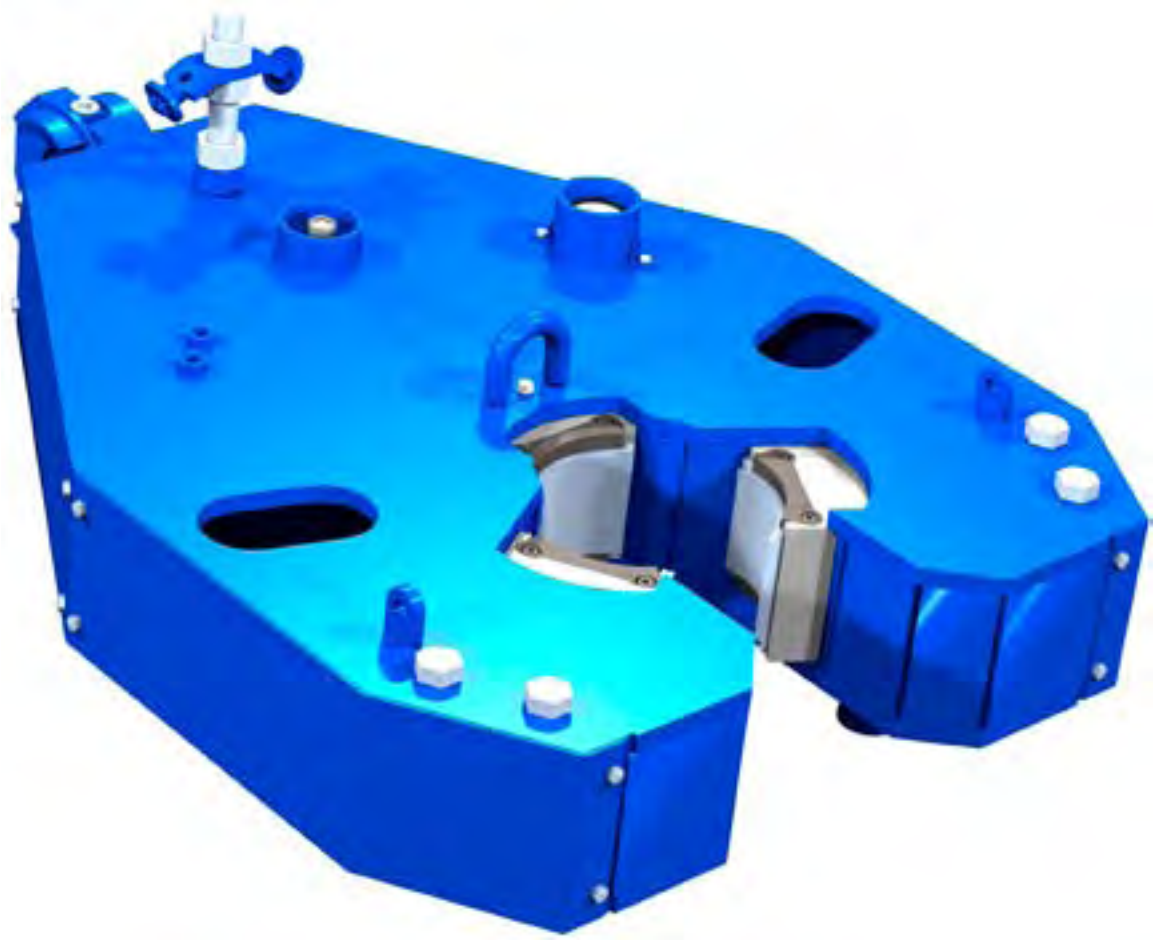
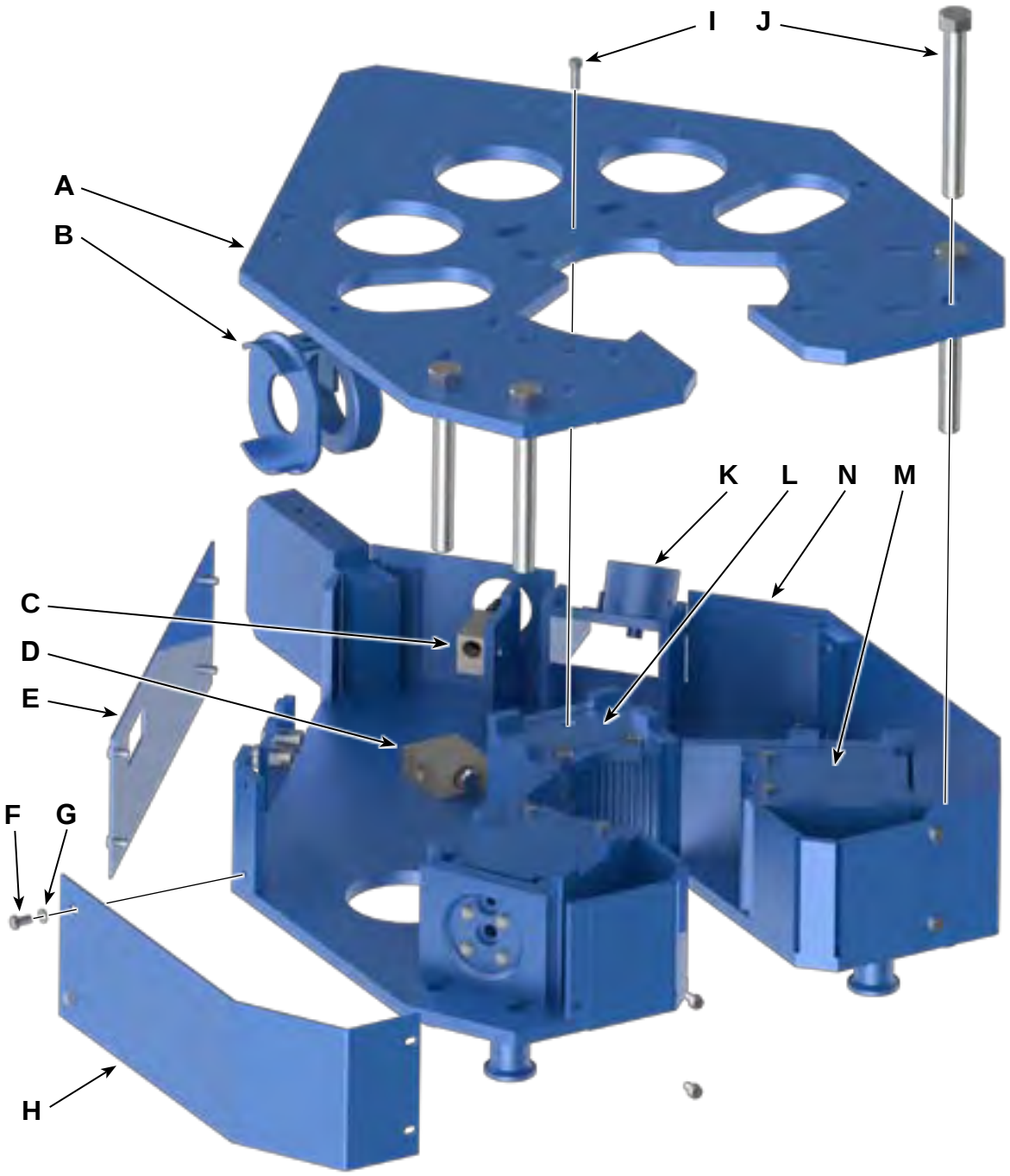


Item	Type	Description	Qty	Part Number
A	Weldment	Load Cell Holder Weldment	1	01-9116D
B	Part	3/8" Regular Flat Washer	1	09-5006
C	Part	3/8" NC x 1-1/4" Hex Bolt	1	09-1048
D	Part	1-1/4" NC Hex Nut	3	09-5832
E	Part	Suspension Spring V-Bracket	1	1483-500-00-04
F	Part	Suspension Spring Retainer	2	1483-500-00-4B
G	Part	1-1/4" NC x 8" Threaded Rod	1	101-1993
H	Part	1/4" NC x 3/4" Hex Bolt	2	09-1005
J	Part	2-1/2" Face 0-3000 PSI 1/4" NPT Gauge	1	02-0246
K	Weldment	Gauge Protector Weldment	1	1483-500-18
L	Part	3/8" NC x 1-1/2" Hex Bolt	1	09-1050
M	Part	3/8" Carbon Steel Lockwasher	17	09-5106
N	Part	1" NC x 8-1/2" Hex Bolt	4	
P	Part	Rear Jaw	1	1403-08
Q	Part	Rear-Side Cover Plate	2	1421-500-11B
R	Part	3/8" NC x 3/4" Hex Bolt	16	09-1044
S	Part	Side Cover Plate	2	1421-500-11
T	Assembly	**CLINCHER®** Cylinder Assembly	2	1403-00-00B
U	Part	1" NC Nylock Nut	4	09-5725
V	Weldment	Backup Body Weldment	1	1421-500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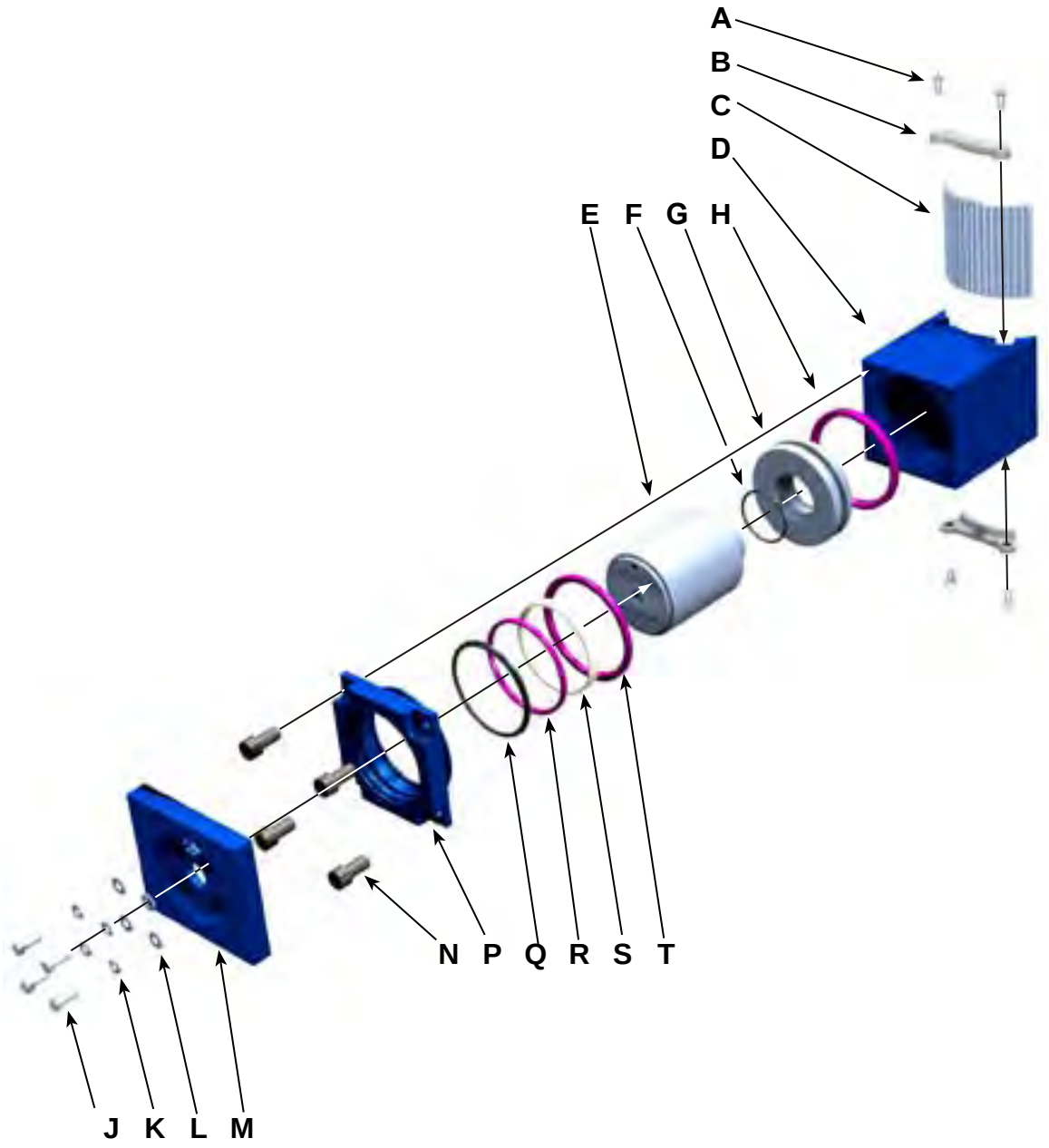
Item	Type	Description	Qty	Part Number
A	Weldment	Backup Body	1	1421-500-LP
B	Weldment	2" Load Cell Holder	1	01-9116D
C	Part	Relief Valve Body	1	08-1839
D	Part	BCJ Body	1	08-1327
E	Part	Rear Cover Plate	1	101-4482
F	Part	3/8" NC x 3/4" Hex Bolt	16	09-1044
G	Part	3/8" Lock Washer	16	09-5106
H	Part	Front Cover Plate	2	1421-500-11
I	Part	3/8" NC x 1 1/4" Hex Bolt	1	09-1048
J	Part	1" NC x 9" Hex Bolt	4	09-0288
K	Weldment	Gauge Protector Weldment	1	1483-500-18
L	Part	**CLINCHER®** Rear Jaw	1	1403-08
M	Assembly	**CLINCHER®** Cylinder Assembly	2	1403-00-00B
N	Part	Rear Cover Plate	1	101-4481
	Part	3000 PSI Pressure Gauge (Not Shown)	1	02-0245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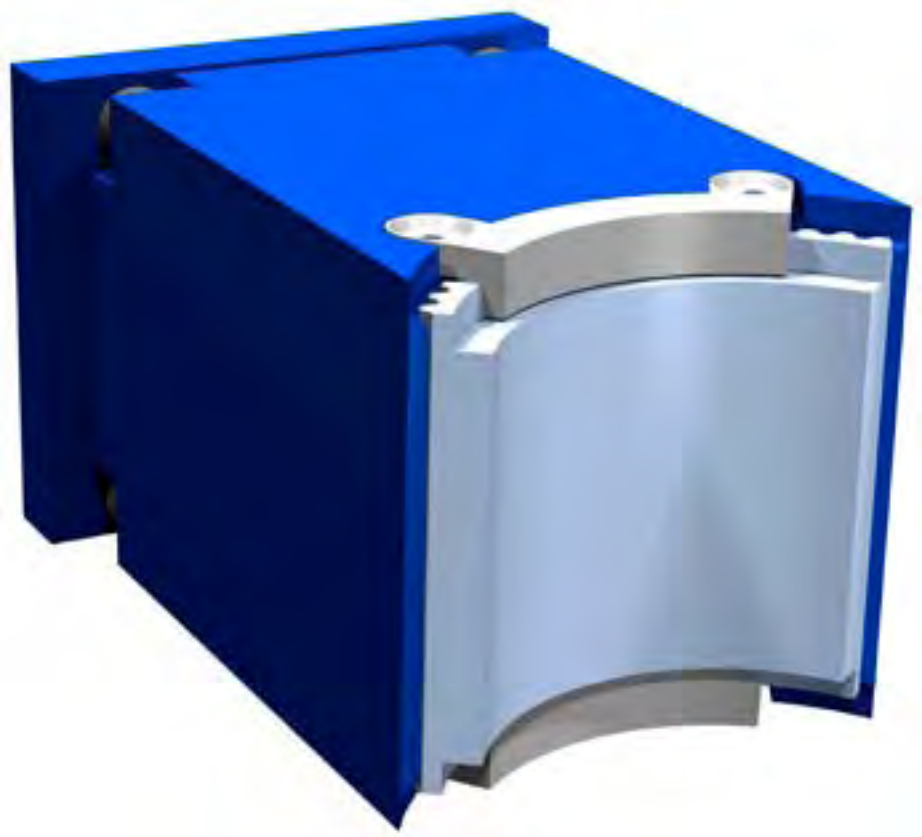
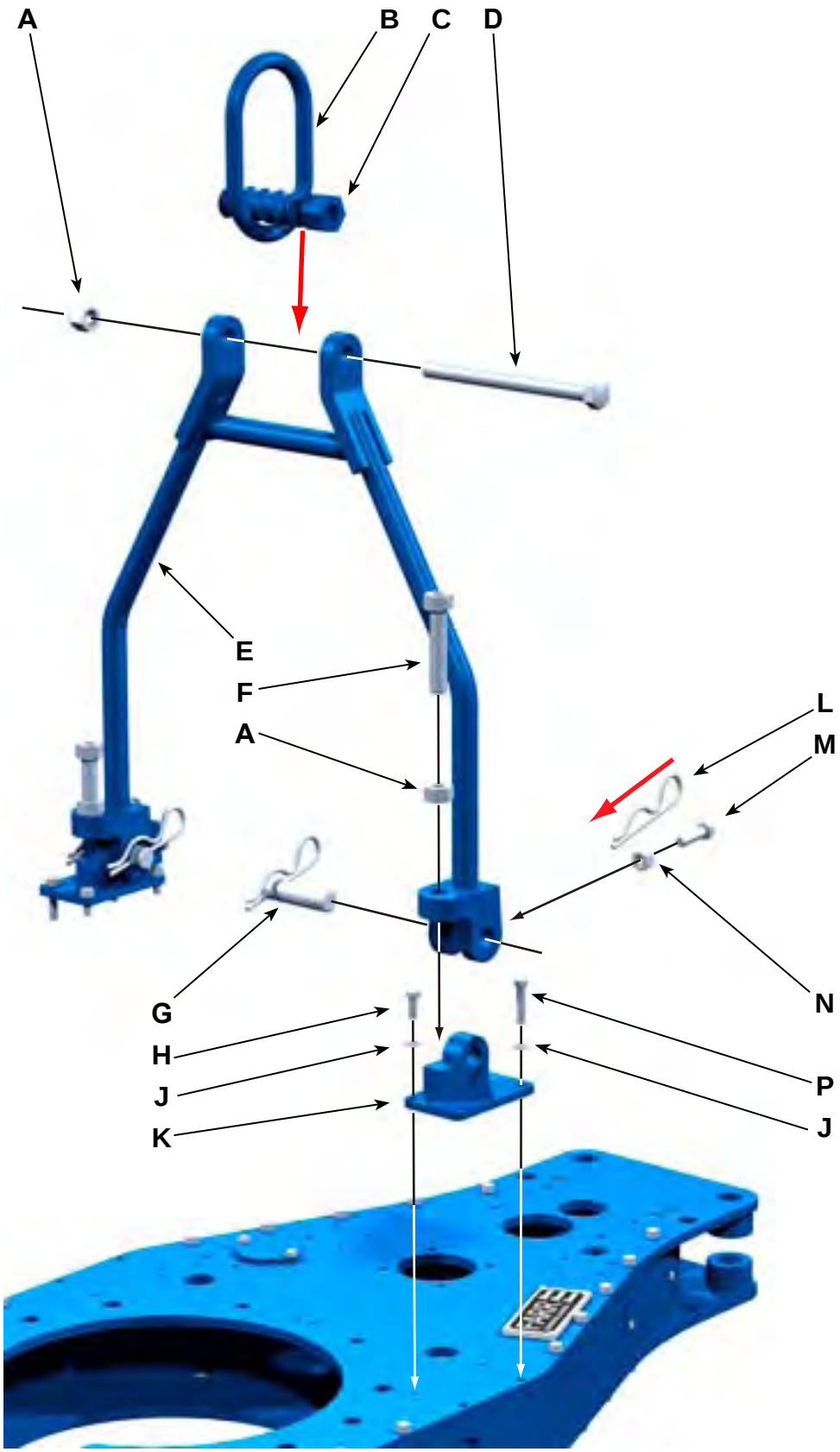


Item	Type	Description	Qty	Part Number
A	Part	3/8" UNF x 1" Hex Socket Flat Head Cap Screw	4	09-4046
B	Part	Die Retainer (Top)	2	101-2981
	Part	Die Retainer (Bottom)	2	101-2290
C	Part	Wraparound Insert (See Pp. 2.14)	1	
D	Part	Cylinder Housing	1	1403-01
E	Part	Cylinder Rod	1	1401-04B
G	Part	Cylinder Piston	1	1401-05B
J	Part	3/8" UNC x 1" Hex Bolt	4	09-1170
K	Part	3/8" Carbon Steel Lock Washer	4	09-5106
L	Part	3/8" Plain Narrow Washer	4	09-5124
M	Part	Backing Plate	1	1403-03
N	Part	5/8" UNC x 1-1/4" Hex Socket Head Cap Screw	4	09-0240
P	Part	Cylinder Gland	1	1401-06B
	Kit	**CLINCHER® Cylinder Seal Kit**		**1401-00-00-SK**
F	Seal	2-231 O-Ring	1	
H	Seal	37504750 POLYPAK	1	
Q	Seal	SH940-41 Wiper	1	
R	Seal	STD 25004500 Polypak	1	
S	Seal	W2-4750-625 Wear Ring	1	
T	Seal	SEAL PARKER POLYPAK 25005000	1	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Item	Type	Description	Qty	Part Number
	Assembly	Chain Sling Assembly	1	101-2211
A	Part	3/4" NC Hex Nut	3	09-5818
B	Part	Lift Link	1	02-0516
C	Part	Adjusting Helix	1	1053-1-H
D	Part	3/4" NC x 9" Hex Bolt	1	09-1322
E	Weldment	Rigid Sling Weldment	1	101-0656
F	Weldment	Leveling Bolt	2	1053-C-1L
G	Part	Rigid Sling Pin	2	1053-C-1C
H	Part	3/8" NC x 1" Hex Bolt	4	09-1170
J	Part	3/8" Carbon Steel Lockwasher	8	09-5106
K	Weldment	LH Rigid Sling Bracket	1	101-0150
	Weldment	RH Rigid Sling Bracket	1	101-0151
L	Part	Hitch Pin, 1/4" x 5"	4	09-9075
M	Part	1/2" NC x 1-1/4" Hex Bolt	2	09-1168
N	Part	1/2" NC Hex Jam Nut	2	09-5810
P	Part	3/8" NC x 1-3/4" Hex Bolt	4	09-1557

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A. BASIC TORQUE MEASUREMENT

Basic torque measurements are performed using a simple hydraulic measurement system. A hydraulic load cell connects to a calibrated torque gauge through a reinforced flexible hydraulic hose. The torque gauge is factory-calibrated to display accurate torque measurements for a tong or tong and backup assembly with a particular arm length. The arm length is a measurement from the centre of the pipe or casing to the centre of the force being applied to the load cell.

Two load cell options are available. A tension load cell is typically used with a suspended stand-alone tong. This application requires that the load cell be attached to the rear of the tong as part of the restraint line that opposes the force generated when the tong makes up or breaks out a joint. A compression load cell is used in a tong and backup assembly, and is typically located on the rear of the backup between the backup and a stationary frame. The load cell must be located in the centre of the compression force vector generated between the backup and the frame.

Hydraulic force generated by a load cell is transmitted to the torque gauge via a reinforced flexible hydraulic line. The hydraulic force is displayed as torque in units of Ft.-Lbs. The torque gauge has a red "peak torque" indicator that tracks with the torque gauge needle to the point of highest torque, and remains at the point of highest torque until manually reset. Note that every model of tong and tong and backup assembly has a unique arm length, and the torque gauge must be calibrated for that arm length. Torque gauges that are not calibrated for the arm length of the tool in service will not display correct torque. To ensure correct torque measurement, ensure the arm length or "handle" as displayed on your torque gauge matches the arm length of the tool in service as listed on the specifications page of the technical manual.

The images on this page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment.

THE IMAGES DISPLAYED ARE SUPPLIED FOR ILLUSTRATION PURPOSES ONLY

ILLUSTRATION 6.A.1: TORQUE GAUGE (FOR ILLUSTRATION PURPOSES ONLY)

ILLUSTRATION 6.A.2: TENSION LOAD CELL

ILLUSTRATION 6.A.3: COMPRESSION LOAD CELL

Torque gauges and load cells are supplied as a matched calibrated pair. Substituting one or the other will render the calibration inaccurate even if the actual model numbers appear to be identical. The serial numbers of matching load cell and torque gauges are clearly identified on the calibration certificate. Should you suspect the accuracy of your torque measurements, or wish to replace either component the pair should be returned to the factory for re-calibration before placing into service.

TORQUE GAUGES AND LOAD CELLS ARE FACTORY-SUPPLIED SUPPLIED AS MATCHED CALIBRATED PAIRS. IF REPLACING EITHER COMPONENT THE LOAD CELL AND TORQUE GAUGE MUST BE RETURNED TO THE FACTORY FOR RE-CALIBRATION BEFORE PLACED INTO SERVICE.

BASIC TORQUE MEASUREMENT (Continued:)

The images on the preceding page are for illustration purposes only and may not accurately represent the torque gauge and load cell that have been supplied with your equipment. Please note that the parts listed in the following table are correct for accurate torque measurement while using the equipment for which this manual is supplied.

THE TORQUE GAUGE USED IS FULLY DEPENDANT UPON THE ARM LENGTH AND TORQUE RANGE OF THE EQUIPMENT IN USE. THE PART NUMBERS LISTED IN THE FOLLOWING TABLES ARE CORRECT FOR ACCURATELY MEASURING TORQUE USING THE EQUIPMENT FOR WHICH THIS MANUAL IS SUPPLIED.

Item	Type	Description	Qty	Part #
	Assembly	30" Arm-20K Tension Load Cell and Gauge	1	10-0028T
A	Part	4.08 in^2 Tension Load Cell	1	10-0008T
B	Part	Torque Gauge, 20,000 Ft.-Lbs. 36" Arm	1	10-0028G
C	Part	Hydraulic Hose	1	02-0069

Item	Type	Description	Qty	Part #
	Assembly	32" Arm-20K Compression Load Cell and Gauge	1	10-0029C
A	Part	8 in^2 Compression Load Cell c/w hoses & fittings	1	10-0008C
B	Part	Torque Gauge, 20,000 Ft.-Lbs., 32" Arm	1	10-0029G
C	Part	Hydraulic Hose	1	02-0069

LOAD CELLS ARE NOT USER SERVICEABLE. ILLUSTRATION 6.A.4 AND 6.A.5 ARE PROVIDED FOR INFORMATION PURPOSES ONLY. DAMAGED LOAD CELLS MUST BE RETURNED TO THE FACTORY FOR REPAIR AND RE-CALIBRATION.

Item	Type	Description
	Assembly	Tension Load Cell, 4.08 in^2
A	Part	1/4" NC x 1/2" Binding Head Machine Screw
B	Part	Stat-O-Seal
C	Part	O-Ring
D	Part	O-Ring
E	Part	Load Cell Piston
F	Part	Flange Gasket
G	Part	Load Cell End
H	Part	Load Cell Rod
J	Part	Wiper
K	Part	O-Ring
L	Part	Load Cell Body
M	Part	3/8" NC x 3/8" Cup Point Hex Set Screw
Seal Kit		Replacement Seal Kit 4.08 in^2 Tension Load Cell

This is the standard tension load cell supplied by McCoy Drilling & Completions | Farr. Contact our sales department for information about optional application-specific tension load cells.

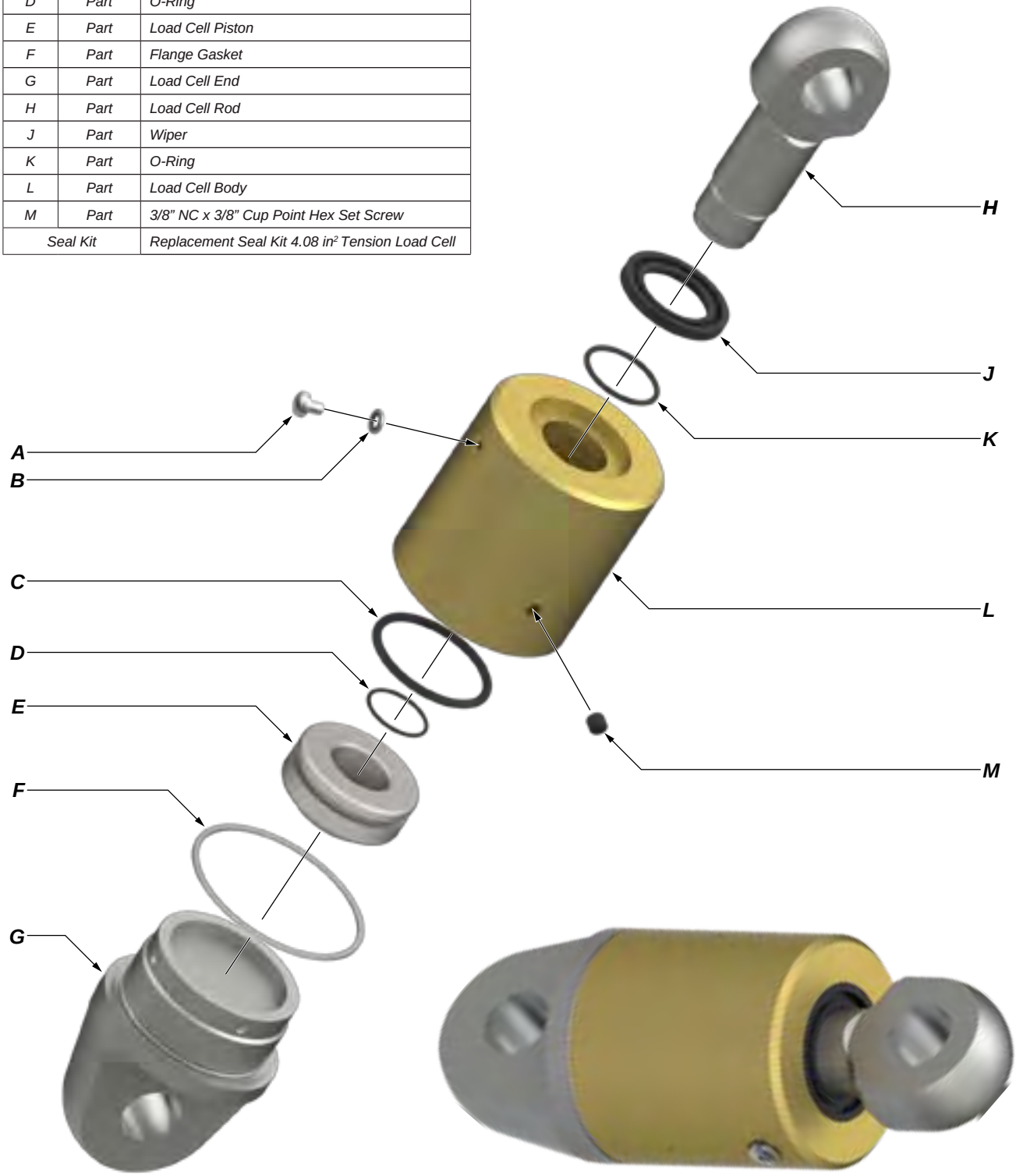


ILLUSTRATION 6.A.4: TENSION LOAD CELL EXPLODED

Compression Load Cell, 8 in²					
Item	**Type**	**Description**	**Item**	**Type**	**Description**
A	Part	5/16" UNC x 1" Hex Socket Head Cap Screw	E	Part	Diaphragm
B	Part	Load Plate	F	Part	Diaphragm Casing
C	Part	5/16" UNC x 3/4" Hex Socket Head Cap Screw	G	Part	Street Elbow
D	Part	Retainer Ring	H	Part	1/4" NPT Brass Plug

This is the standard hydraulic compression load cell supplied by McCoy Drilling & Completions | Farr. Contact our sales department for information about optional application-specific compression load cells.

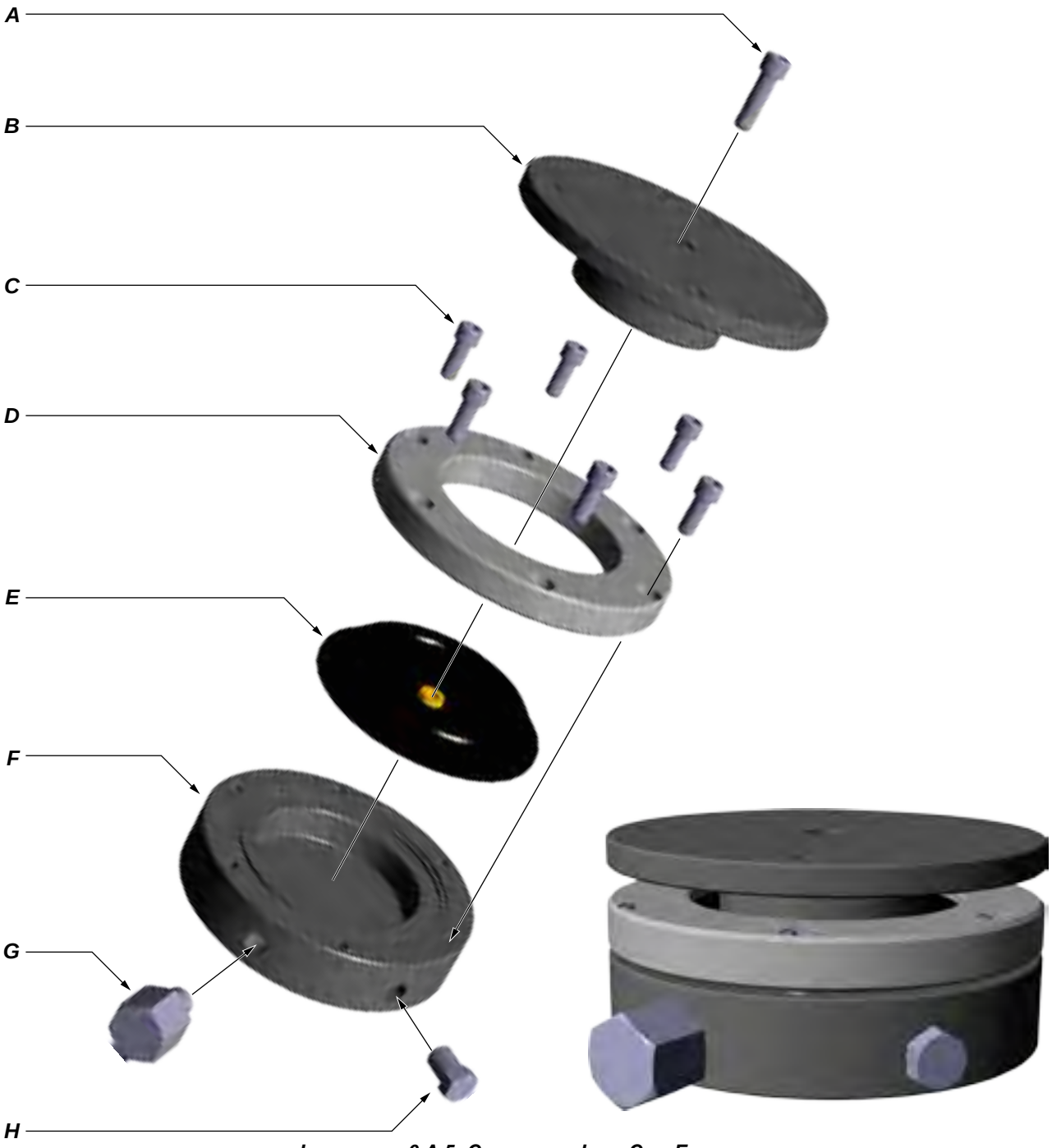
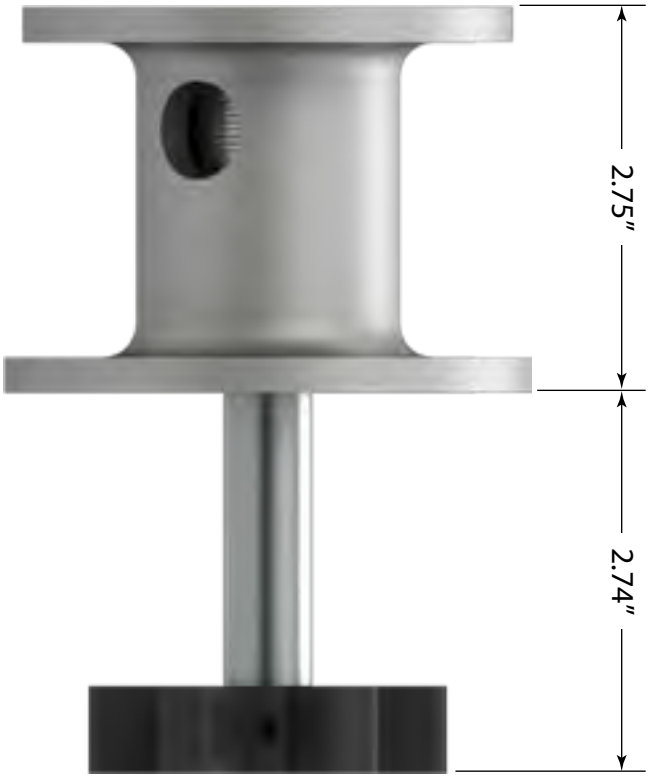
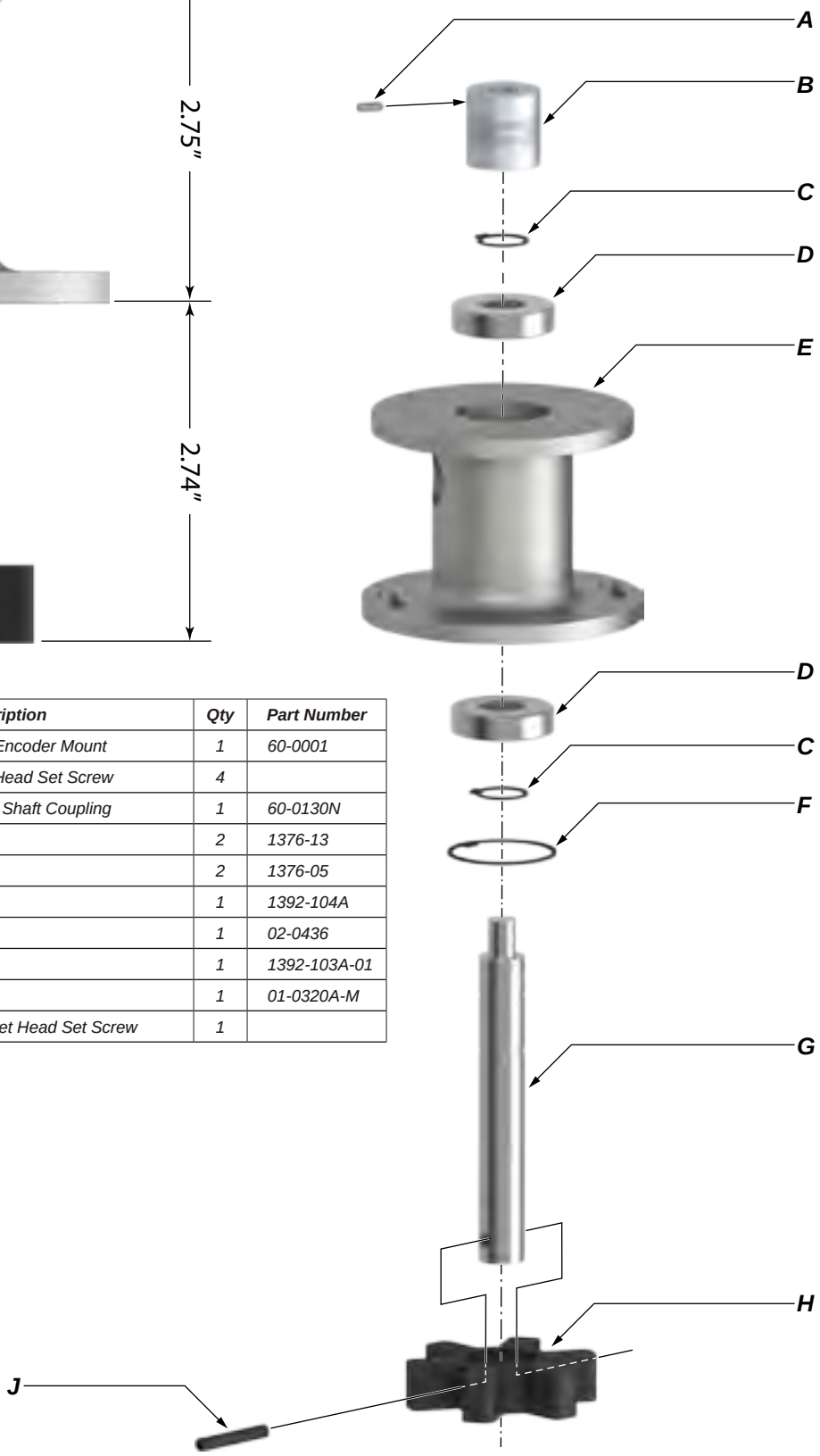


ILLUSTRATION 6.A.5: COMPRESSION LOAD CELL EXPLODED





Item	Type	Description	Qty	Part Number
	Assembly	Standard Turn Counter Encoder Mount	1	60-0001
A	Part	6-32 x 3/8" Hex Socket Head Set Screw	4	
B	Part	Helical Flexible Encoder Shaft Coupling	1	60-0130N
C	Part	Internal Retainer Ring	2	1376-13
D	Part	Bearing	2	1376-05
E	Part	Encoder Housing	1	1392-104A
F	Part	Internal Retainer Ring	1	02-0436
G	Part	Encoder Shaft	1	1392-103A-01
H	Part	Encoder Gear	1	01-0320A-M
J	Part	10-24 x 1-1/4" Hex Socket Head Set Screw	1	

ILLUSTRATION 6.A.6: TURN COUNTER ENCODER MOUNT EXPLODED

B. TROUBLESHOOTING

Under normal operating conditions, and with proper maintenance, the torque gauge and load cell system are designed to give lasting trouble-free performance. Faulty indication on the gauge will very often define a fault within the gauge.

IF TROUBLESHOOTING REVEALS THAT THERE IS INSUFFICIENT FLUID IN THE SYSTEM, BEFORE RECHARGING, CHECK THAT ALL SYSTEM COMPONENTS ARE FREE FROM DAMAGE. THIS WILL ENSURE THAT FLUID LOSS WILL NOT CONTINUE AFTER RELOADING

1. Symptom: No indication on gauge.

Possible Problem: Obstruction in hydraulic hose.
Solutions: Check hydraulic hose for kinks.
Replace hydraulic hose.

Possible Problem: Loss of hydraulic fluid.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Internal mechanism of torque gauge is damaged.
Solution: Replace gauge.

2. Symptom: Gauge indication unexpectedly high.

Possible Problem: Excessive hydraulic fluid.
Solutions: Completely drain hydraulic fluid from torque gauge/load cell system. Recharge following the procedure in Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).
Solution: Replace gauge with gauge properly calibrated for the load cell in service.

3. Symptom: Gauge indication unexpectedly low

Possible Problem: Insufficient hydraulic fluid.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Obstruction in hydraulic hose.
Solutions: Check hydraulic hose for kinks.
Replace hydraulic hose.

Possible Problem: Snub line not at right-angle to tong handle.
Solution: Check angle of snub line and correct if necessary.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

Possible Problem: Incorrect torque gauge in use (not part of the original torque gauge/load cell pair).
Solution: Replace gauge with gauge properly calibrated for the load cell in service.

4. Symptom: Gauge indication is erratic or sluggish

Possible Problem: Insufficient hydraulic fluid in torque measurement section.
Solution: Recharge hydraulic fluid (see Section 6.C). NOTE: Ensure any breaches in the hydraulic system between the load cell and torque gauge are repaired to prevent further fluid loss.

Possible Problem: Loss of damping fluid in torque gauge.
Solution: Top up or refill damping fluid (NOTE: Ensure leakage points in gauge are identified and repaired to prevent further loss of damping fluid).

Possible Problem: Air bubbles in hydraulic fluid in the torque measurement system.
Solution: Bleed air from load cell and torque gauge and top up fluid (if necessary) as per Section 6.C.

Possible Problem: Internal mechanism of gauge is damaged.
Solution: Replace gauge.

C. PERIODIC INSPECTION AND MAINTENANCE

ONLY QUALIFIED, DESIGNATED PERSONNEL ARE PERMITTED TO PERFORM MAINTENANCE ON THE TORQUE MEASUREMENT SYSTEM.

1. Inspection

The torque measurement system supplied with your equipment is designed and built to provide years of trouble-free service with minimum maintenance. Periodic inspections of the load cell, hydraulic lines and fittings are recommended in order to keep the system in top operating condition. A thorough inspection should be made at each rig-up.

2. Fluid Recharge

Recharge hydraulic system with W15/16 fluid through the check valve on the torque indicating gauge. Recharging must only be performed when there is no load on the load cell. Refer to the illustrations on pages 6.3 & 6.4 for guidance if required.

a. *Place the torque indicating gauge higher than the load cell. Remove the brass 1/4" cap from the fitting on the check valve on the top of the gauge.*

b. *Connect the hand pump to the check valve fitting.*

c. *Elevate the load cell so it is higher than the torque gauge and hand pump.*

UN-CONTAINED SPILLAGE OF THE HYDRAULIC FLUID IN THIS SYSTEM MAY CONTRAVENE GOVERNMENTAL ENVIRONMENTAL REGULATIONS, OR THE ENVIRONMENTAL REGULATIONS AND POLICIES OF YOUR COMPANY. FARR CANADA CORP. HIGHLY RECOMMENDS PLACING YOUR LOAD CELL IN A CONTAINMENT BASIN BEFORE PROCEEDING WITH THE BLEEDING & REFILLING PROCESS.

d. *Fill hand pump bowl with W15/16 hydraulic fluid.*

MAINTAIN GREATER-THAN HALF FULL FLUID LEVEL IN THE HAND PUMP BOWL TO AVOID PUMPING AIR INTO THE SYSTEM. DO NOT ALLOW THE LEVEL TO FALL BELOW ONE-HALF FULL

e. *Remove the vent plug screw and Stat-O-Seal (Items C and D on Illustration 6.A.4, or item H on Illustration 6.A.5) to allow trapped air to escape.*

f. *Pump fluid into the system until no more air is seen escaping from the vent port.*

g. *Replace the vent plug screw and Stat-O-Seal and tighten securely.*

h. *Remove load cell from containment vessel and wipe clean. Reclaim the hydraulic fluid (if it is clean) or dispose of all waste materials according to governmental or your company's proscribed environmental protection regulations.*

i. *Disconnect the hand pump from the torque gauge.*

j. *Replace the brass cap on the torque gauge check valve fitting.*

3. Reference Checking Your Torque Measurement System

The following steps define a process for determining if your torque measurement system is correctly measuring and indicating within an expected range. This procedure is best suited for performing in a shop or location removed from the drill floor, within range of a crane. This is a reference check and not a calibration. Calibrations must be performed at an authorized calibration facility.

Tension Load Cell

a. *Locate a known weight in the range of approximately 500 to 1000 lbs (227 to 455 kg), and move the weight next to the tong and backup assembly.*

b. *Remove the tension load cell from the tong, but do not disconnect from the torque gauge.*

c. *Suspend the load cell, piston side up, from a crane capable of supporting the known weight in Step 3a.*

d. *Connect the rod side of the load cell to the known weight, and use the crane to hoist the weight from the surface to be suspended freely.*

e. *Perform a simple calculation to determine the expected indication on the torque gauge based on the known hoisted weight. This is a calculation that must be performed using the arm length expressed in imperial units (feet). The calculation is: [KNOWN WEIGHT] x [ARM LENGTH AS DISPLAYED ON THE TONG PLACARD (in feet)]. For example, if the arm length is 32 inches and the hoisted weight is 1000 lbs the calculation is:*

1000 x (32/12) = 2667

Therefore, the expected indication on the torque gauge should be 2667 lbs-ft.

Reference Checking Your Torque Measurement System (continued):

Tension Load Cell (continued):

e. Perform a simple calculation (continued):

Calculations for a metric torque measurement system using tension load cell are as follows:

[KNOWN WEIGHT (in kg)] x [2.2] x [ARM LENGTH INDICATED ON TONG PLACARD] (in feet)] x [1.356]. For example, if the arm length is 32 inches and the hoisted weight is 500 kg the calculation is:

[500] x [2.2] x [(32/12)] x [1.356] = 3977.6

Therefore, the expected indication on the torque gauge should be approximately 3980 lbs-ft.

Compression Load Cell

a. Locate a known weight, and move the weight next to the tong and backup assembly.

b. Remove the compression load cell from the tong, but do not disconnect from the torque gauge.

c. Place the compression load cell, piston side down, on a sturdy surface such as a concrete shop floor.

d. Use a crane to hoist the known weight on to the rod end of the compression load cell. This is a small area, so an ideal known weight should be relatively small and dense. A block of solid metal or concrete is preferred. The weight must be centered exactly on the rod end of the load cell to ensure even and accurate compression. Do not use a tall unrestrained known weight that could topple. Do not disconnect the known weight from the crane, but ensure the crane exerts no upward force on the weight. The attached crane prevents an un-centered weight from toppling.

e. Perform a simple calculation to determine the expected indication on the torque gauge based on the known weight on the load cell. This is a calculation that must be performed using the arm length expressed in imperial units (feet). The calculation is: [KNOWN WEIGHT] x [ARM LENGTH (in feet)]. For example, if the arm length is 32 inches and the known weight is 500 lbs the calculation is:

[500] x [(32/12)] = 1333.3

Therefore, the expected indication on the torque gauge should be approximately 1333 lbs-ft.

If you are using a metric torque measure system calculations are as follows:

[KNOWN WEIGHT (in kg)] x [2.2] x [ARM LENGTH (in feet)] x [1.356]. For example, if the arm length is 32 inches and the known weight is 250 kg the calculation is:

[250] x [2.2] x [(32/12)] x [1.356] = 1988.8

Therefore, the expected indication on the torque gauge should be approximately 1990 Nm.

4. Repair And Calibration

Return the load cell and indicator gauge to the authorized repair facility for repairs and calibration.

MOVING GLOBAL ENERGY FORWARD

DRILLING & COMPLETIONS

FARR

Section 7: Hydraulic Component Information

The manufacturer information contained in this section has been obtained from publicly available web sites and has been provided for information purposes only. Farr Canada Corp. does not guarantee the accuracy of the information contained in this section. All original copyrights claimed by the manufacturer(s) apply.

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MANUFACTURER OF HYDRAULIC MOTORS
RINEER® HYDRAULICS, INC.

15 series

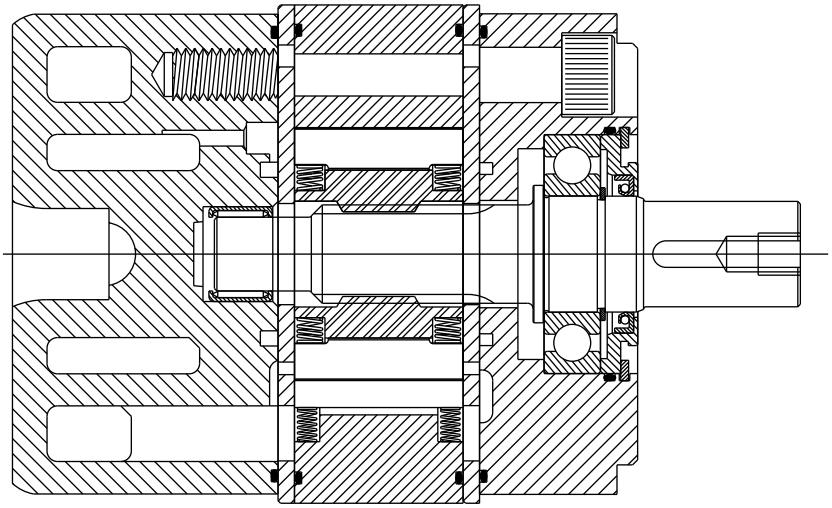
POWER to be the Best!

MOTOR SELECTION GUIDE

Features of the 15 Series Standard Motor: Standard Motor - 3000 PSI (Code 61)

- Eight fixed displacement motors ranging from 6 in^3 to 15 in^3.
- Starting and stall torques equal to 90-94% of theoretical torque.
- Speed to 2,000 RPM continuous.
- Up to 75 HP continuous.
- Conforms to SAE 'C' mounting specification.
- Weighs 43 lbs.

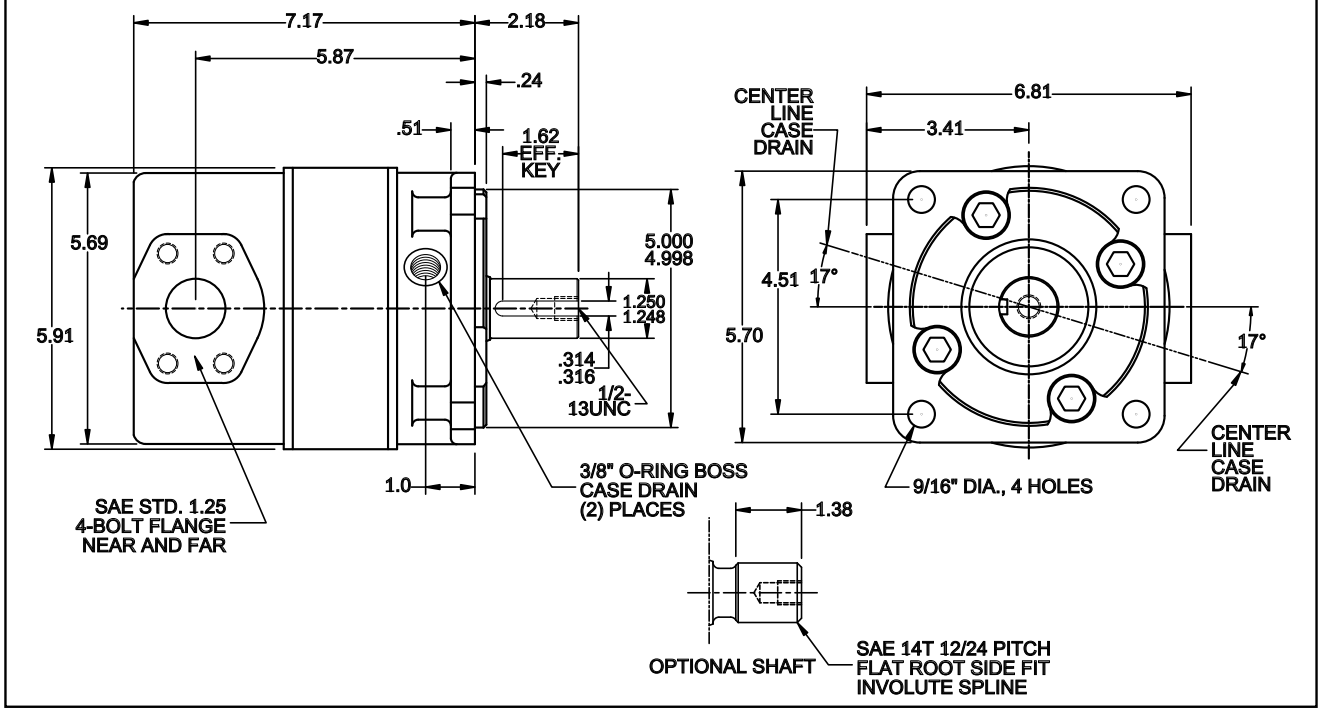
CROSS SECTION



Made in USA

PUBLICATION DS151005 8/03

15 Series Standard Motor Envelope



Technical Information - All Styles

VANE CROSSING VANE
The Rineer patented vane crossing vane design produces much higher volumetric and mechanical efficiencies than is possible with a standard vane type design. This design provides a sealing vane between cavities to improve mechanical and volumetric efficiencies.

STARTING AND STALL TORQUE
The Rineer motor produces torque curves which are virtually flat, with starting and stall torque equal to approximately 90-94% of theoretical torque.

MORE POWER STROKES PER REVOLUTION
The 15 Series has four stator cavities and 10 rotor vanes. Each rotor vane works in each stator cavity once per revolution, which results in 40 power strokes per revolution. This helps produce higher mechanical efficiency and flatter torque curves.

BEARING LOADING
The bearings in the 15 Series can accept radial load per the radial capacity chart. Thrust load is not recommended under most conditions. Consult with a Rineer Application Engineer for optional bearing configurations to match your application.

SEALS
Buna N seals are supplied as standard on the Rineer 15 series motors. Viton seals may be ordered as an option.

ROTATING GROUP - 1S or 1H
Under most operating conditions, 1S (standard rotating group parts) should be used. Under some high speed conditons 1H can be specified.

ROTATION
The 15 Series Motor rotates equally well in either direction and smoothly throughout its entire pressure and speed range. Looking into the end of the shaft, rotation is clockwise when oil is supplied to port "A".

HORSEPOWER LIMITATION
Maximum horsepower limitations may vary with different applications. ***When using the 15 Series Motor above 75 HP, consult a Rineer Application Engineer.***

FILTRATION
25 micron minimum.

FLUID
We suggest premium grade fluids containing high quality rust, oxidation and foam inhibitors, along with anti-wear additives. For best performance, minimum viscosity should be maintained at 100 SSU or higher. Fluid temperature should not exceed 180° F. Elevated fluid temperature will adversely affect seal life while accelerating oxidation and fluid breakdown. Fire resistant fluids may be used with certain limitations. Contact Rineer for additional information.

CASE DRAIN
The 15 Series Motor is designed for either internal or external case drain. Two case drain ports are supplied. When using internal case drain, simply plug the two ports. When using external case drain, use the port at the highest elevation. We recommend case drain pressure of 35 PSI or less when using the standard seals.

CASE DRAIN CIRCULATION
Fluid should be circulated through the case when a temperature differential exists between the motor and the system in excess of 50° F. ***Should this occur, contact a Rineer Application Engineer.***

MOUNTING
The mounting position is unrestricted. The shafts, pilots, and mounting faces should be within .002 TIR.

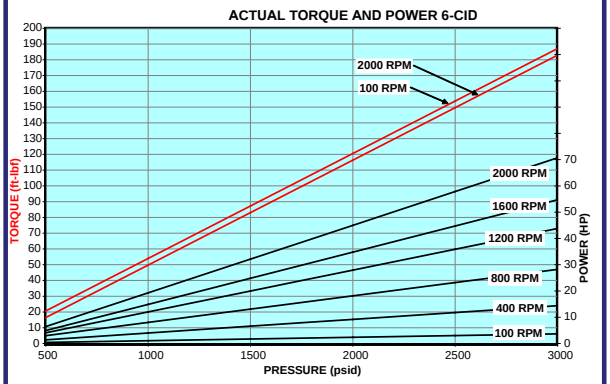
INTERMITTENT CONDITIONS
Intermittent conditions are to be less than 10% of every minute.

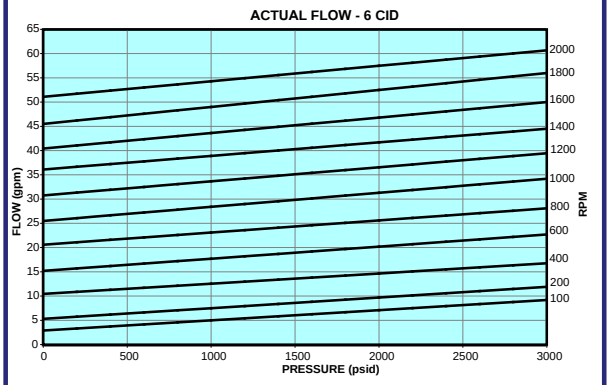
OTHER AVAILABLE MOTORS
For information on additional Rineer Motors, request one of the following publications:

37 Series .....Publication DS371003
57 Series .....Publication DS571003
125 Series .....Publication DS1251003

Performance Data - Selected Displacements

6 C.I.D.





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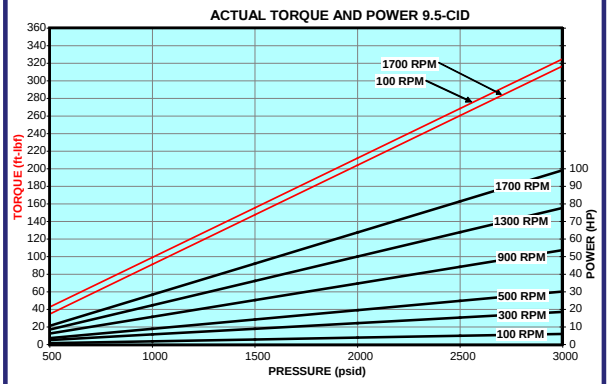

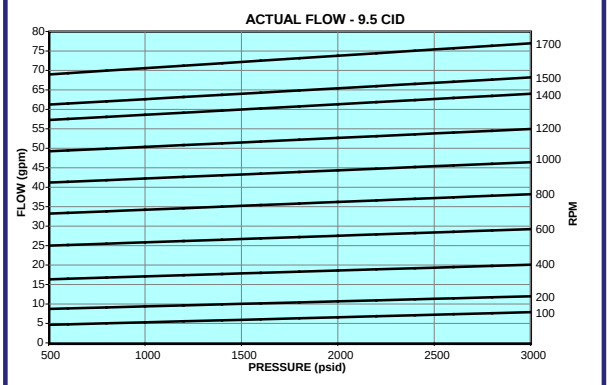

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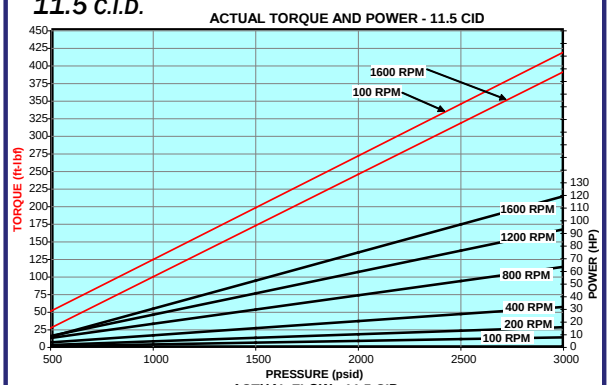

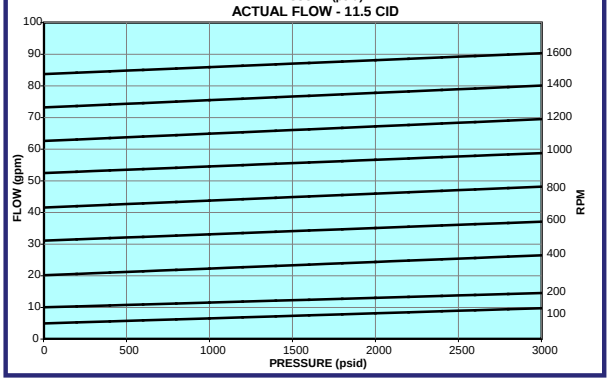

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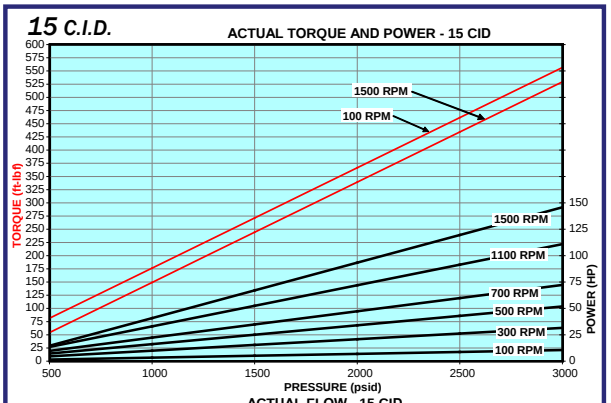
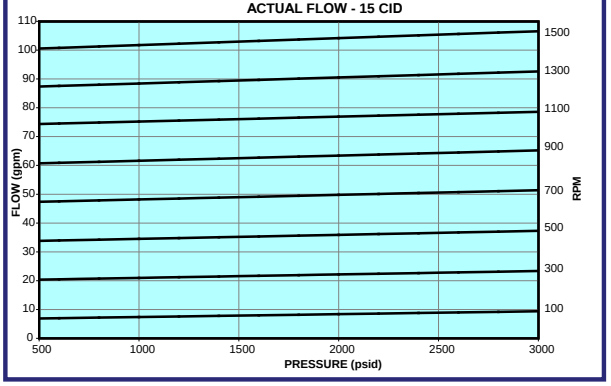




The above performance data was obtained at 140°F with ISO 46(DTE 25). These values must be maintained to obtain the performance indicated. Contact Rineer Hydraulics, Inc. for additional displacements.

Model Code

M015 - 61/62

M015 - 61 = 015 Single Speed
M015 - 62 = 015 Two Speed

Options:
62 = Two Speed Single Pilot Open During Crossover
63 = Two Speed Single Pilot Closed During Crossover
65 = Two Speed Double Pilot Open During Crossover
67 = Two Speed Double Pilot Closed During Crossover

-1S

1S = Std.
1H = High Speed

-015

006 = 6 in^3 (98cc)/rev.
007 = 7 in^3 (115cc)/rev.
008 = 8 in^3 (131cc)/rev.
009 = 9.5 in^3 (156cc)/rev.
010 = 10.5 in^3 (172cc)/rev.
011 = 11.5 in^3 (189cc)/rev.
013 = 13 in^3 (213cc)/rev.
015 = 15 in^3 (246cc)/rev.

-31

30 = Keyed Shaft
31 = Splined Shaft
32 = Wheel Motor
34 = Double Key
50 = Retractable
53 = API Thread

-B1

Bearing Package Selection

-TV

Seal - Package Selection

-000

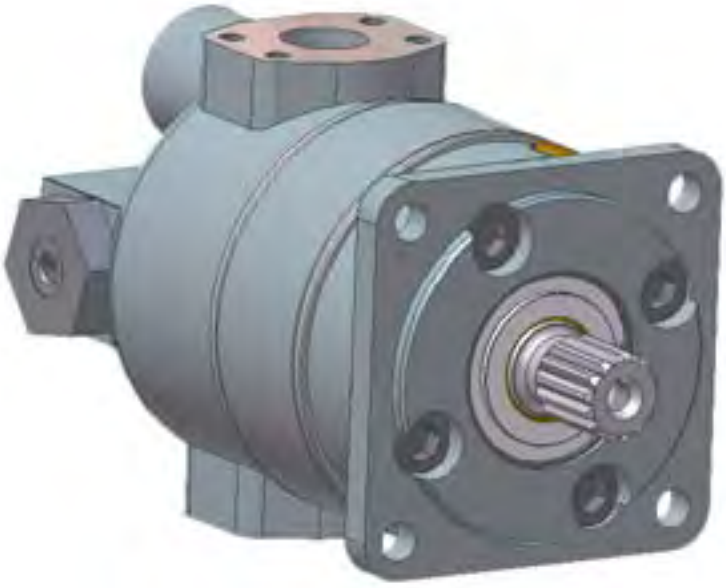
Special Code Designator

Applications

Repair Manual

15 Series

Standard Motor



Two Speed Motor

331 BREESPORT * SAN ANTONIO, TX 78216 * (210) 341-6333 FAX (210) 341-1231

MCCOY DRILLING & COMPLETIONS
MOVING GLOBAL ENERGY FORWARD

SERIES 15 STD. MOTOR EXP. VIEW

ITEM	PART NO.	DESCRIPTION	QTY
1	0150111	SEAL PLATE SNAP RING	1
2	0150135	SEAL PLATE	1
3	0150161	SEAL, SHAFT, TCN	1
4		NOT USED	
5	0150114	SEAL PLATE O-RING	1
6	0150730	SNAP RING, BEARING	1
7	0150710	BALL BEARING	1
8	0150701	SHAFT, KEYED	1
	0150702	SHAFT, SPLINED	1
9	0150901	BOLT	4
10	0150102	FRONT HOUSING-INTERNAL	1
11	0150428	DOWEL PINS - FRONT	2
12	0150610	O-RING	4
13	0150902	BALL CHECKS	4
14	0150620	PLATE SCREW	4
15	0150608	PLATE	2
16	0150400	STATOR GA 11.5	1
	0150401	STATOR GA 15	1
	0150402	STATOR GA 13	1
	0150403	STATOR GA 9.5	1
	0150404	STATOR GA 8.0	1
	0150406	STATOR GA 7.0	1
	0150407	STATOR GA 6	1
	0150409	STATOR GA 3.0	1
17	0150300	ROTOR	1
18	0150313	ROTOR VANE	10
19	0150320	ROTOR VANE SPRING OUTER	20
20	0150321	ROTOR VANE SPRING INNER	20
21	0150410	STATOR VANE	4
22	0150420	STATOR VANE SPRING	8
23	0150429	DOWEL PINS - REAR	2
24	0150720	NEEDLE BEARING	1
25	0150800	REAR HOUSING	1

SERIES: 15
EXPLODED VIEW
MODEL CODE: 015-61-15-015-30-B1-TB-XXX
STANDARD MOTOR
RINEER HYDRAULICS
CORPUS CHRISTI, TEXAS
RECORD REFERENCE
DRAWN BY: JERRY W
DATE: 4-14-98
DWG. NO. 0150041

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

REMOVAL OF SHAFT SEAL

1

1) Remove snap ring

WARNING: Use caution when removing snap ring. If released accidentally it can become an airborne hazard.

2

1) Pry out shaft seal plate with two screw drivers.
2) Remove seal plate o-ring from groove in bearing bore.

REMOVAL OF WHEEL MOTOR SEAL PLATE AND BEARING BOX

3

1) Loosen and remove 8 each 10-32 bolts.
2) Pry off seal plate with screw driver.

4

Loosen and remove 8 each 3/8" bolts with 5/16" socket head wrench.

5

1) Two of the 3/8" bolt holes are provided with jack screw threads.
2) Insert a piece of 1/4" round stock by 2-1/2" long into each jack screw hole
3) Screw two 7/16-14 bolts into the jack screw threads until the bearing box is free of the motor.

6

Lift up on the bearing box to remove from motor.

DISASSEMBLY OF WHEEL MOTOR BEARING BOX

7

1) Loosen clamp screw in lock nut.
2) Unscrew lock nut and remove.

8

1) Press shaft out of bearing box.
2) Proceed to step 9, disregarding steps 11 & 12

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

DISASSEMBLY OF FRONT HOUSING AND SHAFT

9

1) Mark one side of the motor for proper assembly, paying careful attention that the cartridge will not be installed upside down.
2) Secure the motor prior to loosening the 5/8-11 bolts.

10

1) Remove front housing
2) Note: Two 5/16" ball checks and one main body o-ring may be dislodged and fall free.

11

With the seal plate removed, press shaft and ball bearing out of front housing.

12

1) Remove snap ring from shaft.
2) Press shaft out of bearing.

DISASSEMBLY OF ROTOR/STATOR CARTRIDGE

13

Lift up rotor/stator cartridge and remove from the rear housing.

14

1) Place cartridge on any object which will hold it off the table.
2) Remove two each 10-32 place screws.
3) Remove timing plate.

15

1) Remove o-ring and springs with a small screwdriver.
2) Remove dowels pins.

16

1) Replace plate on rotor/stator cartridge.
2) Turn rotor/stator cartridge over.
3) Repeat steps 14 & 15.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

17

1) Remove the rotor.
2) Remove both the rotor and stator vanes.
3) Note: On motors manufactured prior to 1987, rotor vane slots and rotor vanes should be numbered so that vanes can be reassembled in the same vane slot.

INSPECTION AND REPLACEMENT OF PARTS

18

Inspect all springs and seals. We recommend replacement of all seals and springs whenever the motor has been disassembled.

19

Inspect all parts and replace any parts which obviously show excessive wear or damage.

20

VANES: Normal wear results in slight flattening of vane tips which does not impair motor performance. Replace vane if radius is reduced by 50%. Clearance between the rotor vane and rotor vane slot varies with the vane selection. The design allows the vane to "lean" slightly in the slot, providing the required mechanical seal.

21

PLATES: Normal wear results in marking of timing plates which does not impair motor performance. Replacement of the timing plate is required if any smearing, galling, or heat cracks are present.

22

ROTOR: Normal wear results in polishing of rotor faces which does not impair motor performance. Examine the rotor vane slots closely. Polishing down in the slots is normal, but if there is any indication of a "pocket" forming in the wall of the slot, the rotor should be replaced.

23

STATOR: Normal wear results in polishing of cam form which does not impair motor performances.
Noticeable wear may be apparent along the corner of one side of the staor vane slot. This does not necessarily require replacement of the stator, but may slightly affect volumetric efficiency.

24

Note: Measure the rotor and stator length to the fourth decimal point and supply measurement when ordering rotor, stator, or vanes.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

ASSEMBLY OF ROTOR/STATOR CARTRIDGE

25

1) Reverse the procedures in steps 17, 16, 15, and 14
2) NOTE: Make sure that the radiused edge of each stator vane points to the rotor and the radiused edge of each rotor vane points to the stator.
3) NOTE: Make sure springs are seated in the bottom of the spring pocket in both the rotor and stator.

ASSEMBLY OF FRONT HOUSING

26

1) Press bearing onto shaft.
2) Install snap ring.

27

Press shaft and bearing assembly into front housing by pressing on the outer race of bearing.

28

1) Place seal in seal plate.
2) Place seal plate o-ring into groove in the front housing.
3) Press seal plate into front housing.
4) Install snap ring.
5) Proceed to step 30.

ASSEMBLY OF WHEEL MOTOR FRONT HOUSING

29

1) Reverse the procedures in steps 8 thru 3.
2) Screw lock nut onto shaft until all threads are engaged.
3) Tighten clamp screw until lock nut turns with a slight drag.
4) Tighten lock nut until desired rolling drag of bearing is obtained - see procedure Page 9.
5) Tighten clamp screw
6) Tighten all seal plate bolts.

ASSEMBLY OF MOTOR

30

1) Install dowel pins into rear housing.
2) Install ballchecks into rear housings.
3) Install main body o-ring.

31

1) Place rotor/stator cartridge onto rear housing.
2) NOTE: Make sure assembly marks from step 3 are lined up.

32

1) Install main body o-ring into front housing.
2) Install ball checks into front housing.
3) Place a small amount of grease over ball checks and o-ring.
4) Wipe off excess grease.

WARNING: RINEER RECOMMENDS FOLLOWING ALL STANDARD SHOP SAFETY PRACTICES SPECIFICALLY INCLUDING WEARING OF EYE PROTECTION.

33

1) Install dowel pins into rotor/stator cartridge.
2) Pour a small amount of clean oil into the cartridge.
3) Install front housing onto rotor/stator cartridge.
4) Make sure alignment marks are lined up.

34

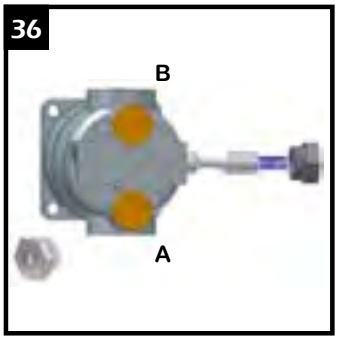
1) Install 5/8-11 bolts.
2) Torque bolts to 50 ft./lbs.

35

1) Rotate shaft in both directions to assure that the shaft turns smoothly.
2) Torque motor to 190 ft./lbs.
3) Rotate shaft again in both directions to assure that the shaft turns smoothly.

SPOOL ASSEMBLY FOR THE TWO SPEED MOTOR

36



NOTE: Spool should be oriented as shown for two speed motors with model codes 62, 63, 68, & 69.

NOTE: Slight design variations may exist in motors manufactured either before or after the printing of this manual.

WHEEL MOTOR SHAFT AND BEARING ASSEMBLY PROCEDURE

1) Clean ALL assembly parts w/ lacquer thinner.
2) Dip clampnut and clamping bolt separately in lacquer thinner.
   (Steps 3 thru 10 must be conducted to completion ONE assembly at a time.)
3) Press bearing cups into bearing housing. Make sure they are pressed completely against bearing shoulders.
4) Coat inner race of large cone with #609 (green) Loctite and press cone onto the shaft. Make sure the cone is completely against the shoulder of the shaft.
5) Insert shaft and large cone into bearing housing.
6) Coat inner race of small cone with #609 (green) Loctite and press small cone onto shaft.
7) Apply #272 (red) Loctite to the clampnut threads of the shaft. Apply #242 (blue) Loctite to the threads of the clamping bolt and install in the clampnut.
8) Spin clampnut onto shaft with the "B" face towards bearings. After the nut threads are fully engaged, but prior to the nut contacting the bearings,
   tighten the clamping bolt until there is drag on the clamping nut (see note Fig. 1). Tighten the nut until a 20 to 30 inch pound rolling torque is achieved.
9) Tighten clamping bolt on clampnut to 70 inch pounds and recheck rolling torque. Apply inspectors lacquer to head of the bolt.
10) Allow a minimum of 24 hrs. to dry.

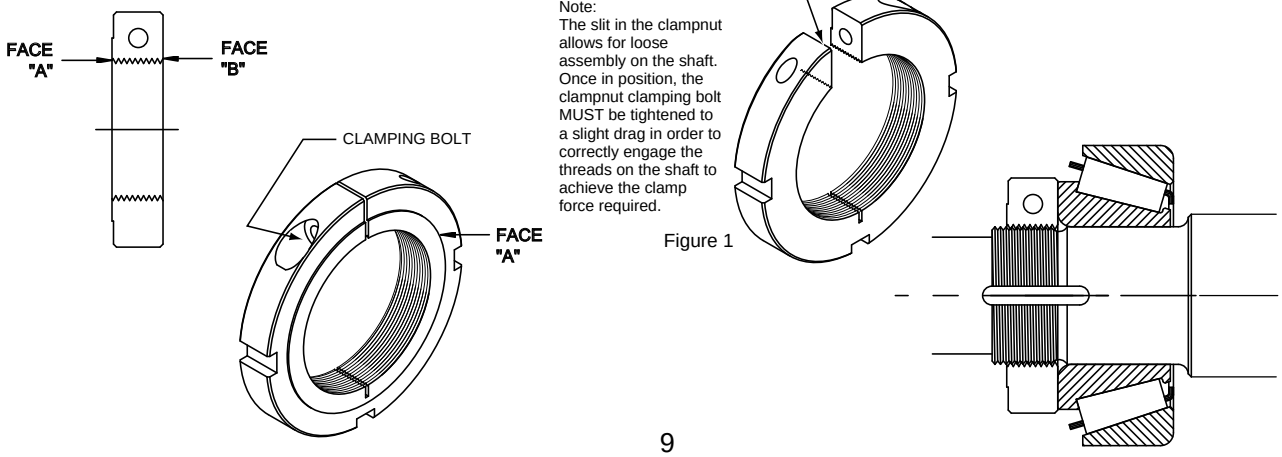

FACE "A"
FACE "B"
CLAMPING BOLT
FACE "A"
CUTAWAY
Note:
The slit in the clampnut allows for loose assembly on the shaft. Once in position, the clampnut clamping bolt MUST be tightened to a slight drag in order to correctly engage the threads on the shaft to achieve the clamp force required.

Figure 1

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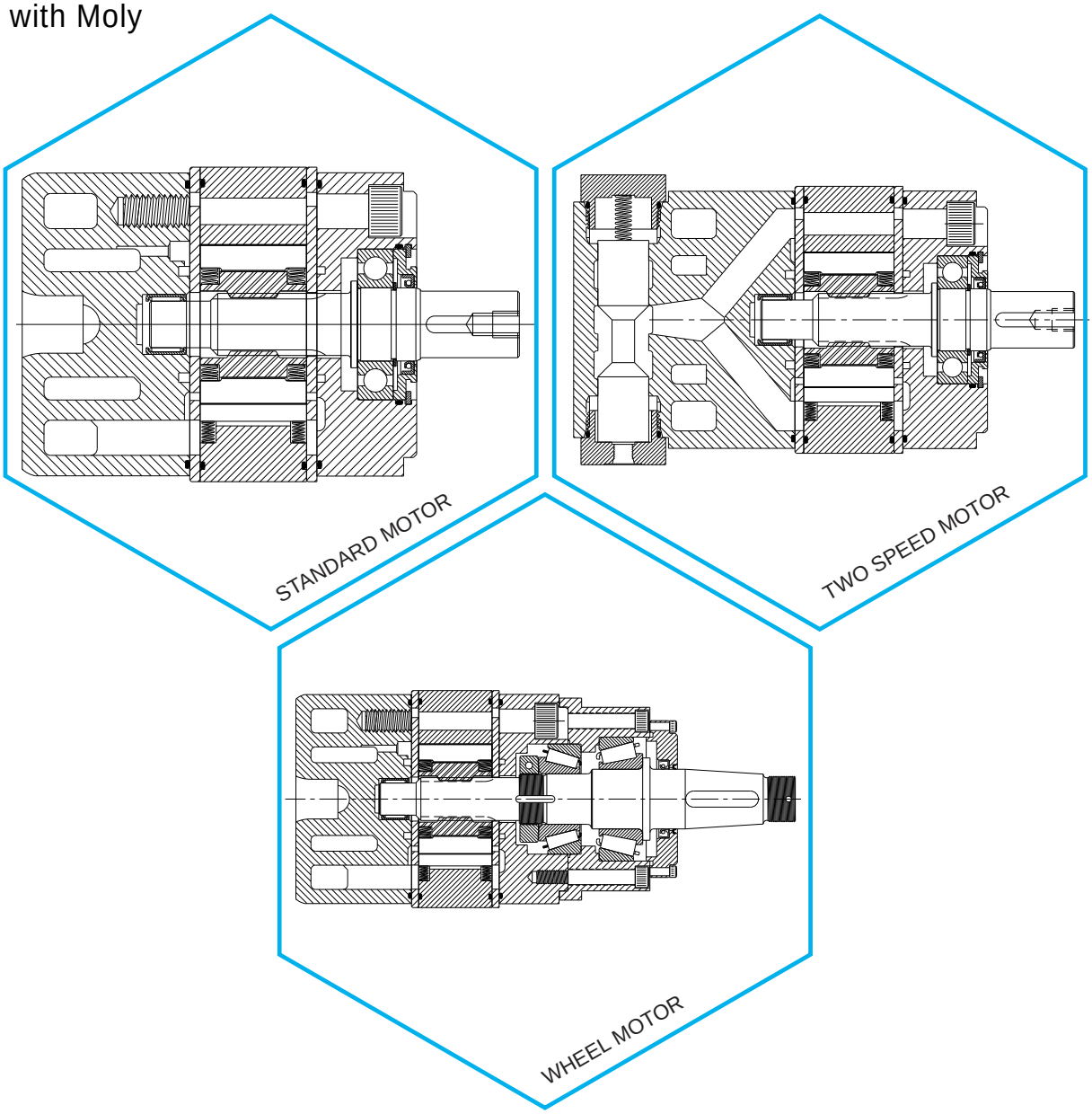
Information:

Bolt Torque -
Main Bolts (5/8-11): 190 ft. lbs.
Seal Plate (3/8-16)
(Wheel Motor only): 45 ft. lbs.
Grease used for bolt threads
and o-ring retention:
Pennzoil 707L RED
Shaft seal assembly lube:
Mobilgrease special
with Moly

Seal Kits:
Standard 15 series seal kit
#0150940
Standard 15 two speed seal kit
#0150940
Standard 15 wheel motor seal kit
#0150936

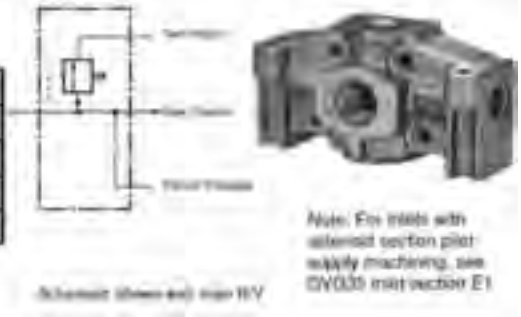


Inlets (2500 psi)

End Inlet

Code	End Port	Top Port
DVA35-A440	1" NPT	1" NPT
DVA35-A880	SAE-16	SAE-16
DVA35-A980	SAE-20	SAE-16
DVA35-A000	NON-PORTED HOUSING	

NOTE: Inlets are machined for 3 main R/V or R/V plug and are furnished with plastic closures. See Section G, Page 32 for inlet port plugs.



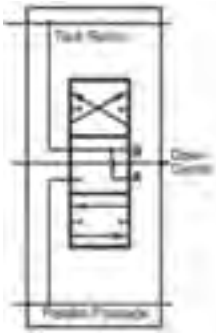
Note: For inlets with solenoid section pilot supply machining, see DVG35 inlet section E1

Outlets

Tank Return Type

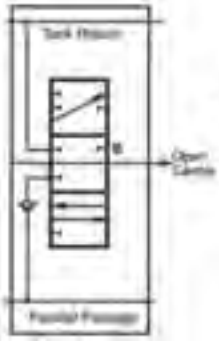
Code	End Port	Top Port
DVA35-TR55	1 1/4" NPT	1 1/4" NPT
DVA35-TR99	SAE-20	SAE-20
DVA35-TR00	NON-PORTED HOUSING	

NOTE: See Section G, Page 32 for Port Plugs



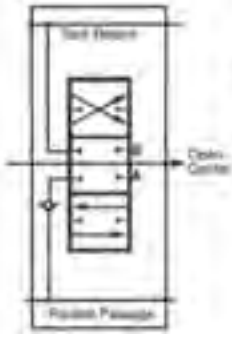
MA8

Double-Acting Section
4-Way, 3-Position, Float in Neutral
Motor Spool



SA8

Single-Acting Section
3-Way, 3-Position, Hold in Neutral
Cylinder Spool



DA8

Double-Acting Section
4-Way, 3-Position, Hold in Neutral
Cylinder Spool

Adjustable Relief Valve Cartridges

For Inlets and Mid-section Inlets

Code	Description
DVA35-MRV-1	Main R/V pressure range 800-2000 psi. Factory set @ 1500 psi @ 50 gpm
DVA35-MRV-2	Main R/V pressure range 2001-2500 psi. Factory set @2500 psi @ 50 gpm
DVA35-MRVP	Main relief valve plug

Lo-Boy Work Sections -- Parallel Circuits

Code													
DVA35-DA0	•					•	•						
DVA35-DA4	•				1"NPT		•						
DVA35-DA8	•				SAE-16		•						
DVA35-SA0		•				•	•						
DVA35-SA4		•			1"NPT		•						
DVA35-SA8		•			SAE-16		•						
DVA35-MA0			•			•	•						
DVA35-MA4			•		1"NPT		•						
DVA35-MA8			•		SAE-16		•						
DVA35-DK8-12V	•				SAE-16						12 VDC		
DVA35-DK8-24V	•				SAE-16						24 VDC		
DVA35-DX4	•				1" NPT				•				
DVA35-DX8	•				SAE-16				•				
DVA35-DV4	•				1" NPT							•	
DVA35-DV8	•				SAE-16							•	
DVA35-MX4			•		1" NPT				•				
DVA35-MX8			•		SAE-16				•				
DVA35-DB4	•				1" NPT			•					
DVA35-DB8	•				SAE-16			•					
DVA35-SB4		•			1"NPT			•					

Brief Circuit Descriptions

Series Circuit

Available in DVA20 sections only.

If a machine's work cycle requires simultaneous as well as separate operation of individual hydraulic work functions, a series circuit is right for the job.

As with the other circuits, the oil flows through the open center when all spools are in neutral. There is no parallel passage in standard series sections because they feed directly from the open center passage. If more than one spool is operated, pump flow goes first to the section closest to the inlet. Return flow from the first section is fed back into the open center for use by downstream sections.

Downstream sections can be series, parallel or tandem and will operate in series with the upstream section.

In series circuits, operating pressure is cumulative. Therefore, the sum of the pressures in the circuits can not exceed the circuit or main relief valve setting.

Parallel Circuits

Parallel circuits are the most common on mobile equipment because more than one function can be operated simultaneously and at random. If two or more functions are fully operated at the same time, the one with the lighted load will assert priority because the fluid will take the path of least resistance. However, the operator can divide the flow between functions by metering the spools.

Movement of the spool meters or shuts off the flow of oil thru the open center passage and pressurizes the parallel passage. Oil is then available, at the operator's discretion, to all work ports connected to the parallel passage.

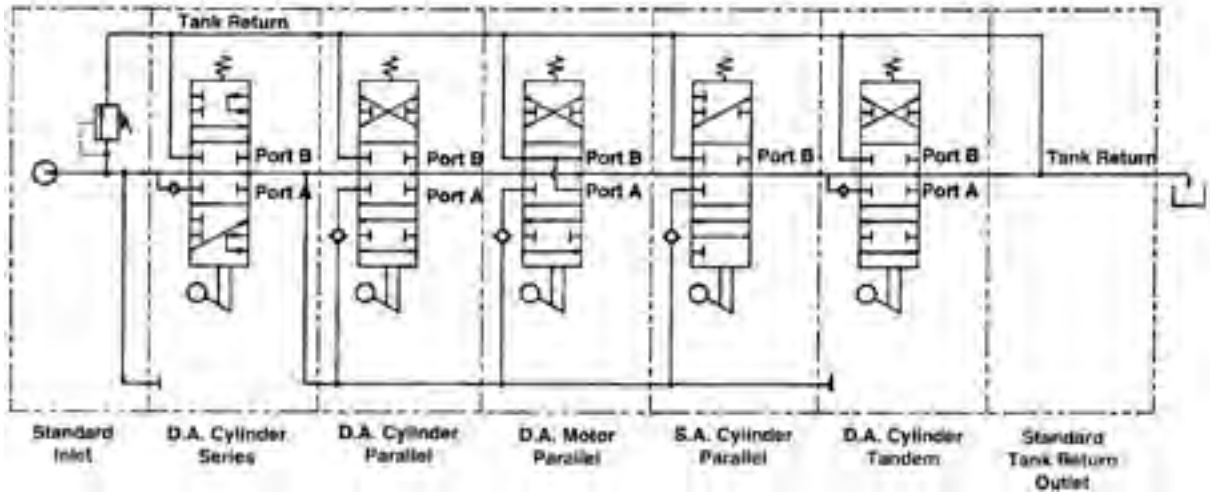
Tandem Circuits

(Not available in the program)

Tandem circuits are sometimes called priority or standard circuits by other manufacturers. Tandem sections feed from the open center passage like series sections but the return flow is directed to the tank return passage and is not available downstream.

If a tandem section is followed by a series or tandem section, operating the tandem section nearest the inlet will assert priority and downstream sections will not function.

Typical Work Section Schematics



MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

VA™/VG™ Valve Service Instructions

INTRODUCTION

This manual has been prepared to assist you in the proper maintenance of the VA20™/VA35™ and VG20™/VG35™/VG80™ directional control valves. Before any work is done, we suggest that you read the assembly and disassembly instructions completely.

The first rule of good maintenance is cleanliness, which includes a clean environment. MAKE SURE YOU DISASSEMBLE AND ASSEMBLE YOUR HYDRAULIC EQUIPMENT IN A CLEAN AREA. Dirt is the natural enemy of any hydraulic system.

GENERAL INFORMATION

The VA and VG model valves are updated versions of our proven A20™ and A35™ units. The VG models are cast from compacted graphite, a high strength iron alloy, which allows the valve to be rated to 3500 psi. VA models are cast from gray iron and are rated at 2500 psi. These open-center, directional-control valves are available in parallel, tandem, and series circuitry. As needed, the sectional, stack-type construction provides flexibility for the addition of subtraction of work sections to an existing valve bank. This design also permits the combination of parallel, tandem, and series circuitry in a single bank. The internal coring of each valve section determines its circuitry and the number of gasket seals required.

All sections with optional features, such as port relief valves, crossover relief valves, and anti-cavitation checks, are dimensionally larger when measured from the top of the port to the bottom of the housing. These are referred to as "hi-boy" sections. Those without work-port options can use the low-profile castings, which are called "lo-boy" sections.

REPLACEMENT PARTS

The illustrations and instructions in this manual apply only to the VA/VG series assemblies, subassemblies, and components. All valve components, except for spools and housings, are available as replacement parts or subassemblies. Spools are hone-fitted to their individual housings, so damage to either of these components means the entire section must be replaced.

We recommend that you use only genuine VA/VG series replacement parts in your service program. Manufactured to the same exacting tolerances and quality controls as the original equipment, genuine VA/VG replacement parts may help prevent premature, component failure and costly downtime. Service parts and assemblies are available through your original equipment dealer or any authorized distributor.

MAINTENANCE

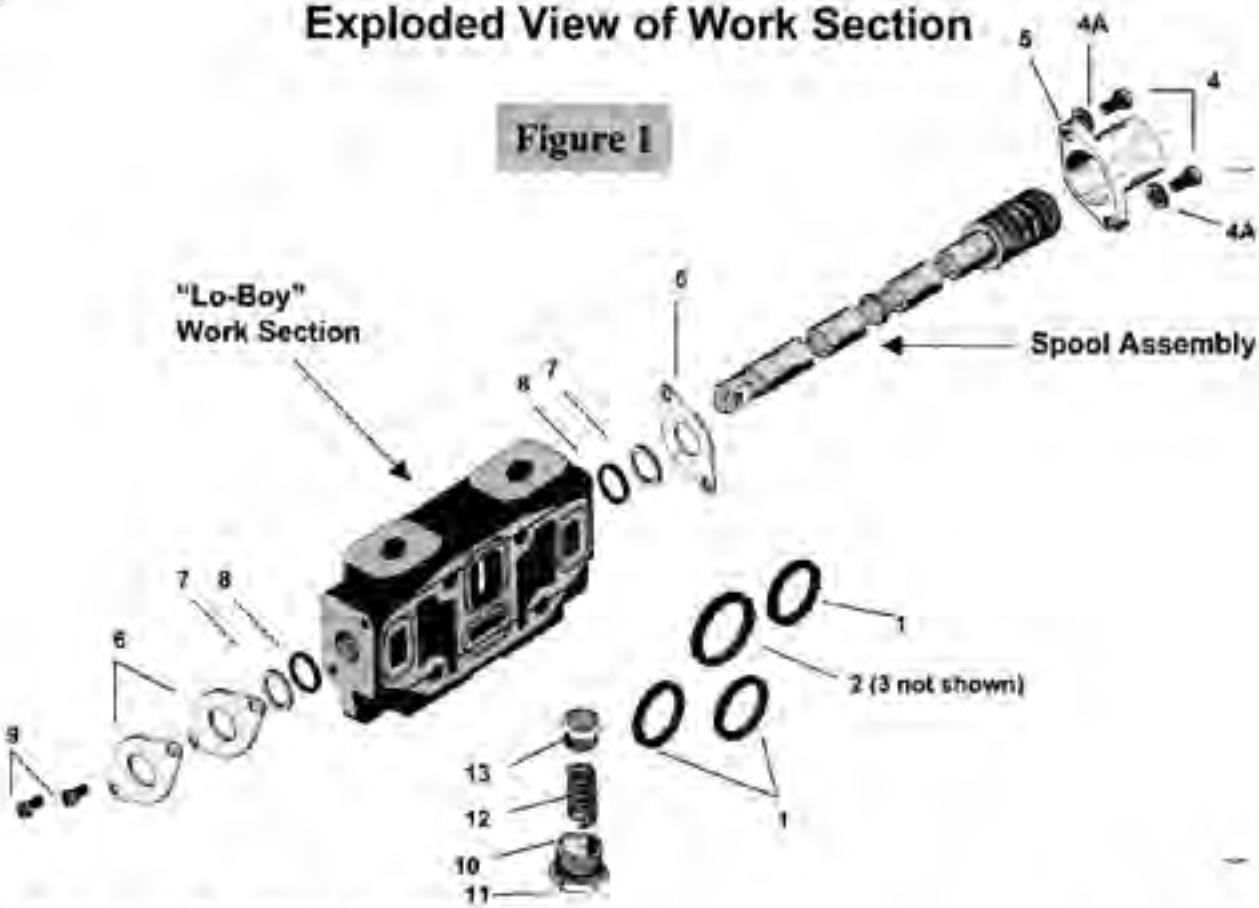
Valves are often used in hazardous environments. Inspect them frequently for damage due to improper use, corrosion or normal wear. If needed, repairs should be made immediately.

Always refer to the machine manual for the proper procedure to remove the valve from the machine.

Remove the valve bank from the equipment, disconnecting all hoses, fittings, control handles and linkage connectors that might be attached to the valve. Plug all ports and thoroughly clean the exterior of the valve bank, then the port plugs can be removed.

Exploded View of Work Section

Figure 1



Parts List For Work Section

Item	Description	Qty.	VA/VG20 Part No.	VA/VG35 Part No.	VG80 Part No.
Parallel Section Seals* See Figure 1					
1.	Square Seals	3	391-2881-206	391-2881-200	391-2881-433
2.	Square Seal	1	391-2881-200	391-2881-403	391-2881-670
Series Section Seals					
1	Square Seals	2	391-2881-206	391-2881-200	.....
3.	Square Seal	1	391-2881-627	391-2881-628	.....
Parallel and Series Section Component Parts. See Figure 1					
4.	Back Cap Screws	2	391-1433-020	391-1433-009	(4) 391-1402-068
4A	Lock washers	8	.....	.....	391-3783-039
5	Back Cap	1	341-6000-100	342-6000-100	341-0585-099
6	Retainer Plates	3	391-2183-001	391-2183-005	391-2183-157
7	Back up Rings	2	391-2681-376	391-2681-426	391-2681-285
8	Spool Seals	2	391-1985-014	391-2887-212	391-2881-096
9	Retainer Plate Screws	2	391-1433-015	391-1433-002	(4) 391-1402-015
10.	Check Valve Cap	1	391-0581-044	391-0581-044	391-0585-099
	Or Valve Cap (F.I.N.)	1	391-2281-015	391-2281-015	.....
11.	O Ring Seal **	1	391-2881-204	391-2881-204	391-2881-249
12.	Check Spring **	1	391-3581-713	391-3581-713	391-3581-778
13.	Check Valve Popper **	1	391-2481-069	391-2481-069	391-2383-091

*Parallel Sealing Face includes inlets and mid-inlets.

**Not required in Float-in-neutral Sections.

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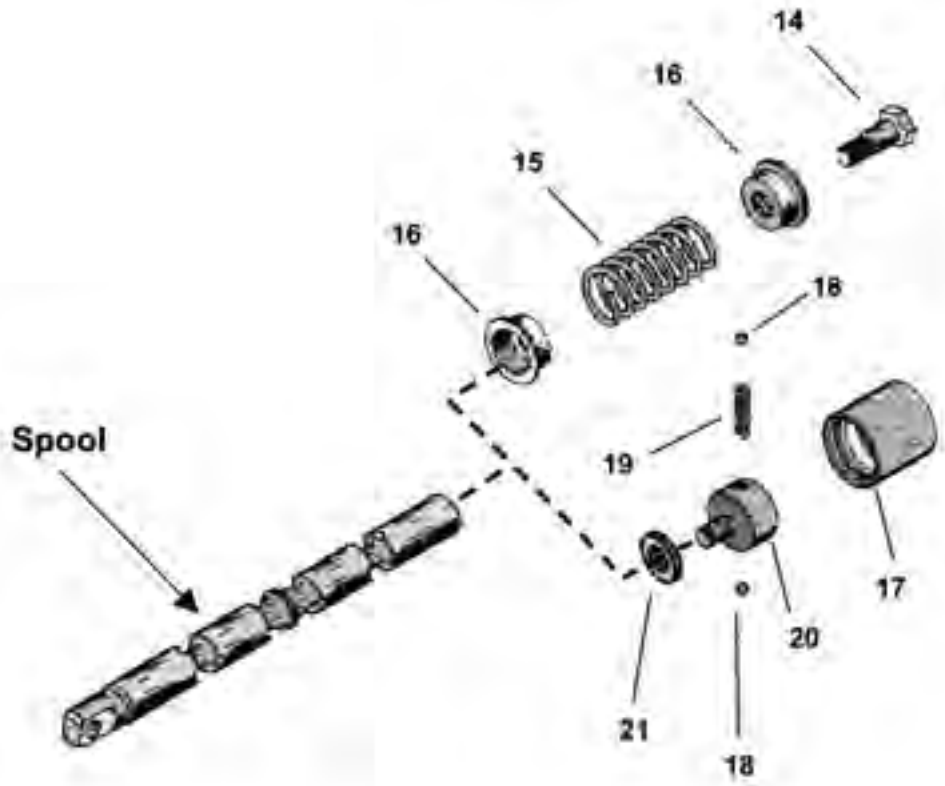
Figure 2



Spring Centered and Detent Spool Operators. See Figure 2

14.Stripper Bolt	1	391-1432-022	391-1432-021	391-1402-452
15.Centering Spring	1	391-3581-608	391-3581-633	391-3581-330
16.Spring Guides	2	391-1642-045	391-1642-013	391-1642-161
17.Detent Sleeve	1	391-3283-015	391-3283-008	391-3384-310
18.Detent Balls	2	391-0282-010	391-0282-009	391-0282-011
19.Detent Spring	1	391-3581-130	391-3581-015	391-3581-316
20.Detent Poppet Retainer	1	391-2583-008	391-2583-006	391-3384-311
21.Detent Spacer	1			391-3782-208

4

Valve Disassembly Instructions

Reference exploded view and parts list on page 2 and 3 for work section detail.

Step 1 - Valve Bank

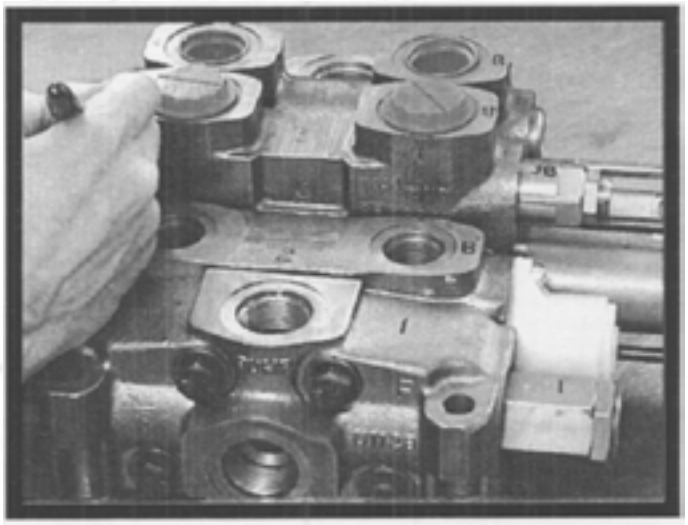
This step is the most critical in the disassembly procedure. It should be followed closely to ensure that the valve bank is properly reassembled after repairs have been made.

With a waterproof, quick-drying marker, mark each casting with a sequential number. Start by marking the inlet casting with the #1 and finish by marking the outlet with the highest number.

Next, mark the port boss closest to the back cap on each work section with a "B" (for back cap end).

Then, mark the port boss closest to the spool clevis on each work section with a "C" (for clevis end).

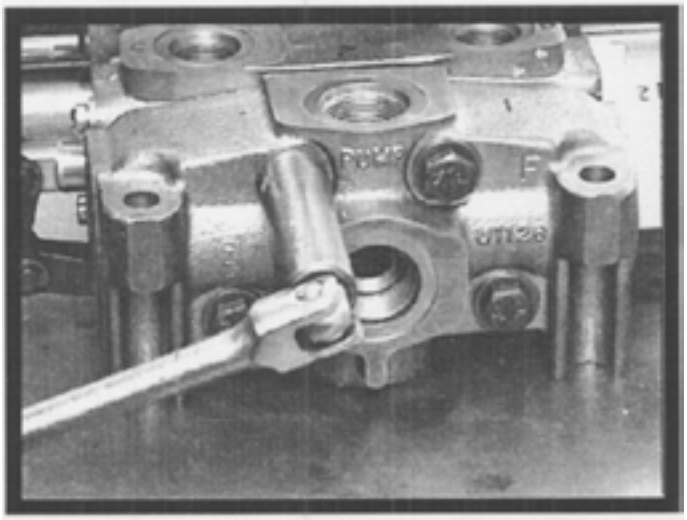
Finally, if relief valves are removed from the valve bank they must be marked with the corresponding number of the casting and port location (B or C) from which they were removed. Inlet and mid-inlet relief valves are marked with a casting number only.



Step 2 - Tie Bolts

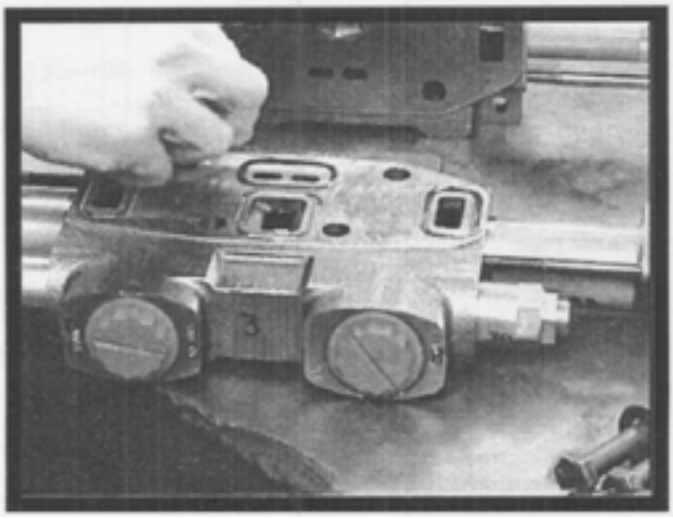
Remove the four, tie bolts that hold the bank together and separate the sections.

NOTE: VA valve tie bolts thread into the outlet casting. VG valve tie bolts pass through the entire bank, requiring washers and hex nuts to be fastened at both ends of the bolt.



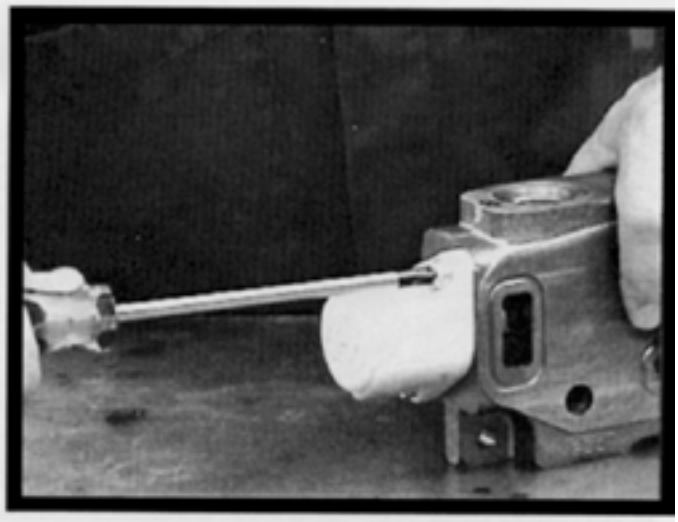
Step 3 - Section Seals

The inlet, mid-inlet and each parallel work section have four, section seals (Fig. 1, items 1 & 2) on the downstream mating face. Series work sections and the VA/VG35 split flow mid inlets have three section seals on the downstream mating face, (Fig. 1, items 1 & 3.) These section seals should be removed and discarded.



REMINDER: ALL WORK MUST BE PERFORMED IN A CLEAN AREA.

Valve Disassembly Instructions



Step 4 - Valve Back Cap

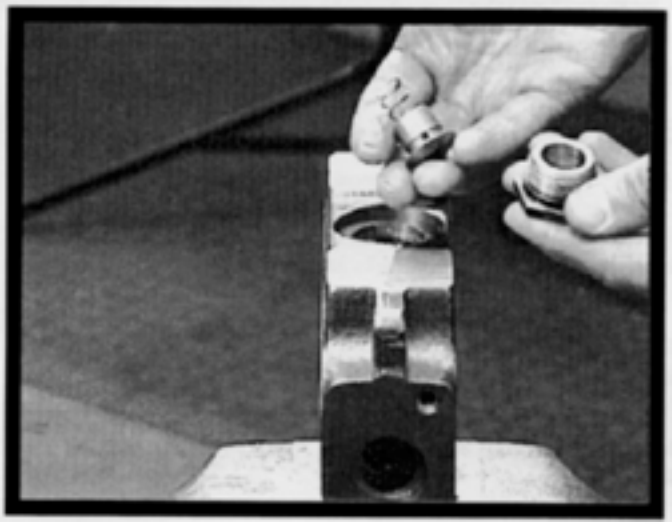
Using a large, Phillips-head screwdriver, remove the two, cap screws (Fig. 1, item 4) which fasten the back cap to the work section. Lightly tap the end of the screwdriver handle with a hammer to break adhesive. Remove the back cap (Fig. 1, item 5).

Step 5 - Control Spool and Seals

Grasp the spring end of the spool with a clean, lint-free cloth and pull the spool out of the housing using a twisting motion. Generally, the rear, retainer plate (Fig. 1, item 6) back-up ring (Fig. 1, item 7) and spool seal (Fig. 1, item 8) will come out with the spool.

CAUTION: For detented spool models, be careful not to remove the detent poppet sleeve (Fig. 2, item 17) unless it is to be serviced.

Using a large, Phillips-head screwdriver, remove the two, retainer-plate screws (Fig. 1, item 9) from the spool sleeve end of the work section. Lightly tap the end of the screwdriver handle with a hammer to break the adhesive. Remove the two, retainer plates (Fig. 1, item 6) the back-up ring (Fig. 1, item 7) and the spool seal (Fig. 1, item 8). Tag or mark with the appropriate, work section identification number. (See Step 1.) Spool seals (Fig. 1, item 8) and back-up rings (Fig. 1, item 7) should be discarded.



Step 6 - Transition Check

The transition check is located in the bottom center of the work section housing. Carefully clamp the work section in a vise with ports down. Do not clamp on the machined surface. Remove the check-valve cap (Fig. 1, item 10) and its O-ring seal (Fig. 1, item 11). Discard the seal. Remove the check spring (Fig. 1, item 12,) and the check-valve poppet (Fig. 1, item 13).

NOTE: Only cylinder work sections (ports blocked in neutral) have a transition check. Motor sections have only a cap plug.

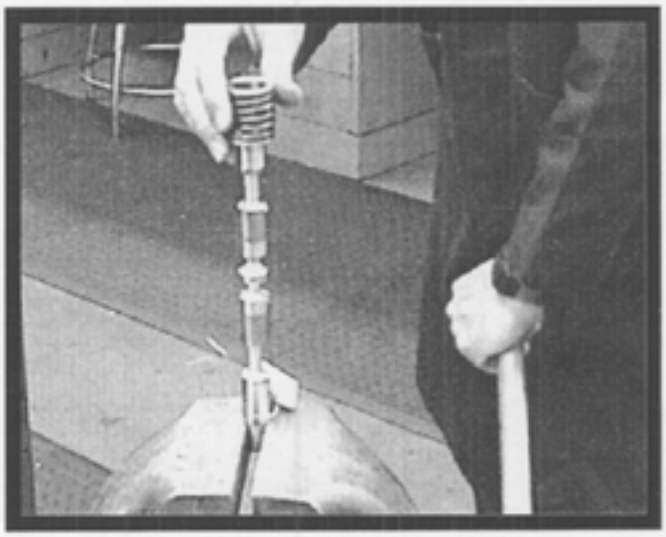
6

Valve Disassembly Instructions

Spool Disassembly

Spring Centered Spool

The spring assembly should not be removed from the spool unless these parts need to be replaced. Once the spool is free of the work section housing, it must be handled carefully to avoid damage. Place the spool vertically in a soft-jawed vise, clamping on the flat, spool clevis, and remove the stripper bolt (Fig. 1, item 14) with a wrench.



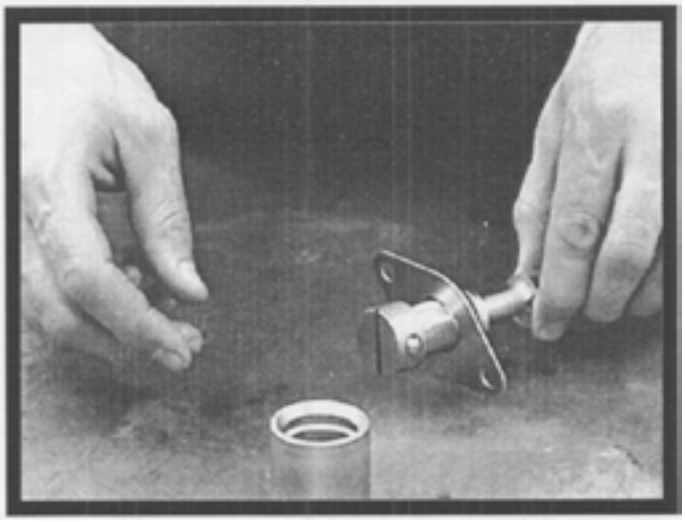
Lightly tap the stripper bolt with a hammer and a punch to help break the adhesive. Cautious application of heat may be required to free the stripper bolt, since an anaerobic thread adhesive was used during its assembly.

CAUTION: Too much heat may distort the spool.

As the stripper-bolt threads disengage, the spring (Fig. 2, item 15) and spring guides (Fig. 2, item 16) will release abruptly from the spool.

Detent Spool

The detent assembly should not be removed from the spool unless these parts need to be replaced. Wrap the detent sleeve (Fig. 2, item 17) with a clean, lint-free cloth. Grip the cloth-covered sleeve and pull firmly. As the sleeve moves backwards, the detent balls (Fig. 2, item 18) and the detent spring (Fig. 2, item 19) will release abruptly. The cloth should capture these parts and prevent their loss.



Next, clamp the spool in a soft-jawed vise and remove the detent poppet retainer (Fig. 2, item 20). Place an undersized bar through the detent ball bore to serve as a wrench. Lightly tap the detent poppet retainer with a hammer and a punch to help break the adhesive. Cautious application of heat may be required again, since an anaerobic adhesive was also used in the detent retainer assembly.

CAUTION: Too much heat may distort the spool!

CLEANING, INSPECTION, AND REPAIR

1. Inspect the spool bore, transition check seat and spool from each section for deep scratches, gouges or excessive wear. If any of these conditions exist, replace the section. Minor surface damage on the control spool and check poppet can be carefully polished away with a very fine, crocus cloth.

2. Examine the machined surfaces of the valve housing for nicks and burrs that could cause leakage between sections. Lightly stone these surfaces to remove any rough spots.

CAUTION: A shallow-milled relief area extends across the O-ring face of the valve housing. This should not be stoned or ground off!

3. Wash all parts thoroughly in a cleaning solvent and blow dry before beginning reassembly. Pay special attention to the number and letters marked on the parts in Step 1. If any marks are removed during cleaning, re-mark immediately.

4. Clean adhesive from threads of spool, stripper bolt, housing, cap screws and hex nut with Loctite™ Chisel Gasket Remover.

Valve Assembly Instructions

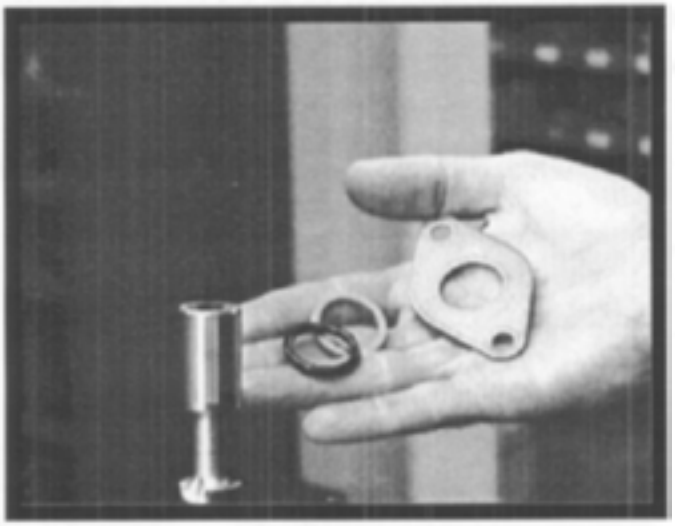
7

Preparation of Parts

Spray the threads of the new stripper bolt (Fig. 2, item 14) tapped-threaded spool end, all screws and screw holes on both ends of the housing with LOCQUIC Primer Grade NF™ and let dry.

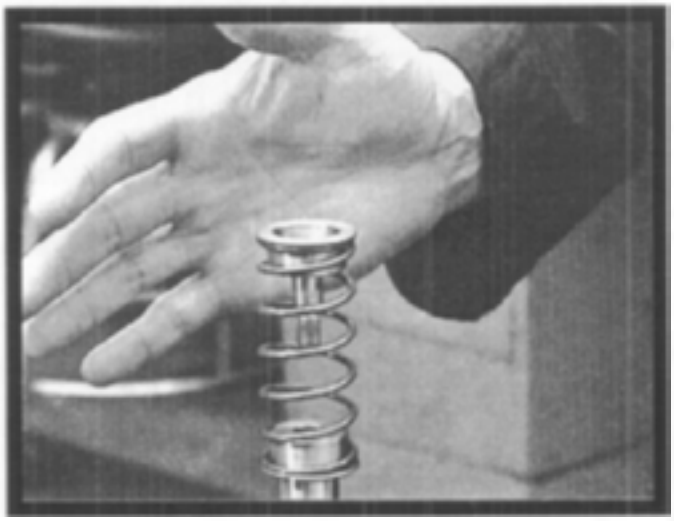
CAUTION: Failure to follow the recommended assembly instructions can result in poor performance or product malfunction. Product should be thoroughly tested to ensure proper operation before the valve is placed back into service.

Spring Center Spool Assembly



Step 1 - Spool Assembly-Spring Centered

Clamp the flat, clevis end of the control spool in a soft jawed vise. Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the end of the spool away from the clevis. Slide on the back up ring (Fig. 1, item 7) and retainer plate (Fig. 1, item 6). Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches.



Step 2 - Attach Spring Guides and Spring

Apply 2 - 3 drops of Loctite 262™ or equivalent anaerobic adhesive near the middle of the female threads in the spool. Assemble the spring guides (Fig. 2, item 16) centering spring (Fig. 7, item 15) and stripper bolt (Fig. 2, item 14,) onto the spool (Reverse of Step 7). Torque the stripper bolt to 175 in. lbs +/-4 in. lbs.

CAUTION: Care must be taken to ensure that the spring retainer is not pinched under the shoulder bolt during assembly. This can result in burrs that may cause spool binding. Check for binding by compressing the spring and guides or by rotating the spring guide nearest the housing.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure!

Lightly coat the centering spring with high- temperature grease to prevent rusting. Set the spool assembly aside and let it cure for a minimum of 1 hour. After curing, test the stripper bolt to make certain it can withstand 125 in./lbs. of breakaway torque.

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Valve Assembly Instructions

Detent Spool Assembly

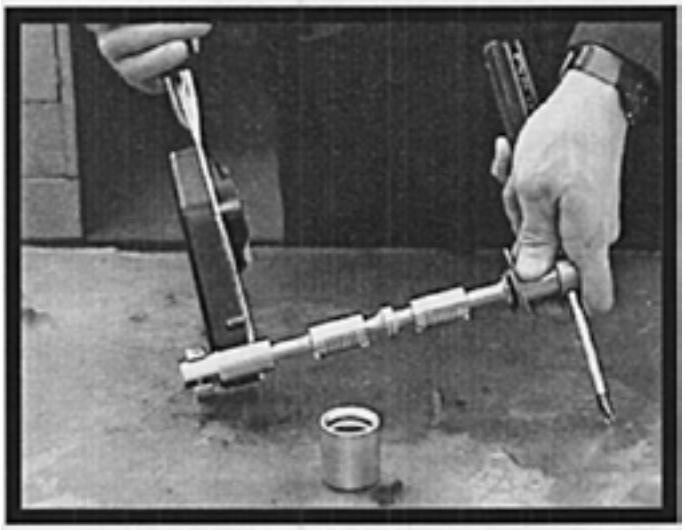
Step 1 - Spool Assembly-Detent

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide the back-up ring (Fig. 1, item 7) and one retainer plate (Fig. 1 item 6) onto the spool. Position these items onto the spool, so that they do not interfere with the spool operator mechanism during assembly. Do not allow the O-ring to come in contact with the sharp edge of the spool notches. Apply 2 - 3 drops of Loctite 262™ or an equivalent, anaerobic adhesive near the middle of the female threads in the spool.

CAUTION: Follow the adhesive manufacturer's instructions for proper cleaning and curing. Failure to clean and prepare parts properly may result in assembly failure.

Step 2 - Spool Assembly-Detent

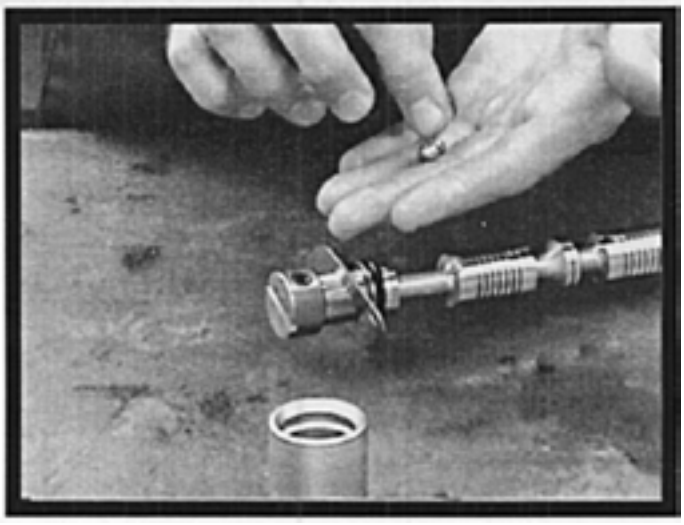
Thread the detent ball retainer (Fig. 2, item 20) into the spool end. Torque the detent ball retainer to 175 in. lbs +/-4 in. lbs. This can be accomplished by using a crows-foot socket on the flats of the clevis, and holding the spool by inserting a round, steel rod or screwdriver through the hole in the ball retainer.



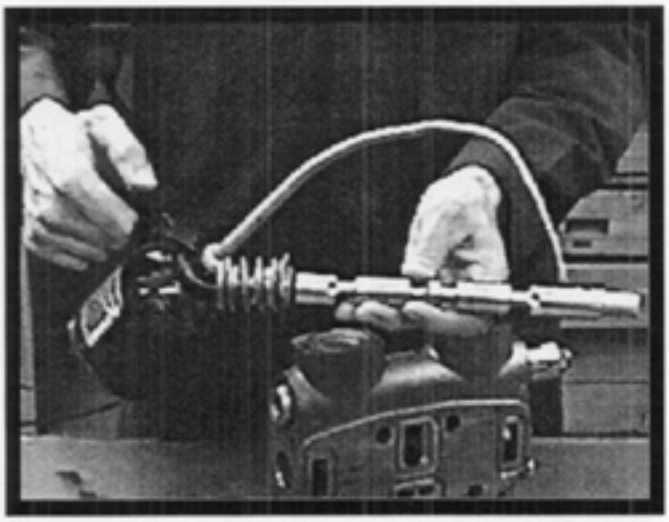
Step 3 - Detent Balls and Spring

Next, lightly coat the detent balls (Fig. 2, item 18) detent spring (Fig. 2, item 19) and entire inside diameter of the detent sleeve (Fig. 2, item 17) with high-temperature grease.

Insert the detent spring into the through hole in the detent ball retainer. Place the steel balls on the ends of the spring. Compress the balls and spring, then slip on the detent sleeve. (Note: The detent sleeve is not symmetrical, one end of the sleeve has a lead-in chamfer. This chamfer must face the spool clevis when assembled.) Move the detent sleeve to the neutral or middle position to prevent the subassembly from separating during subsequent steps.



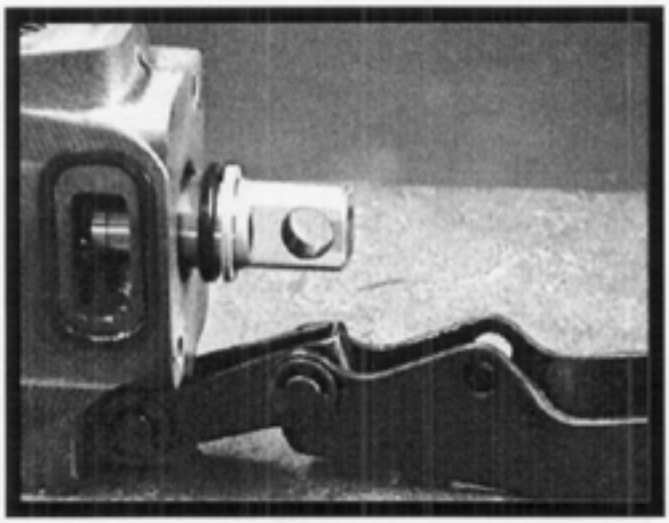
Valve Assembly Instructions



Step 1 - Spool Subassembly

Apply 2 - 3 drops of Loctite 262™ or equivalent to the fillister screw holes on both ends of the housing.

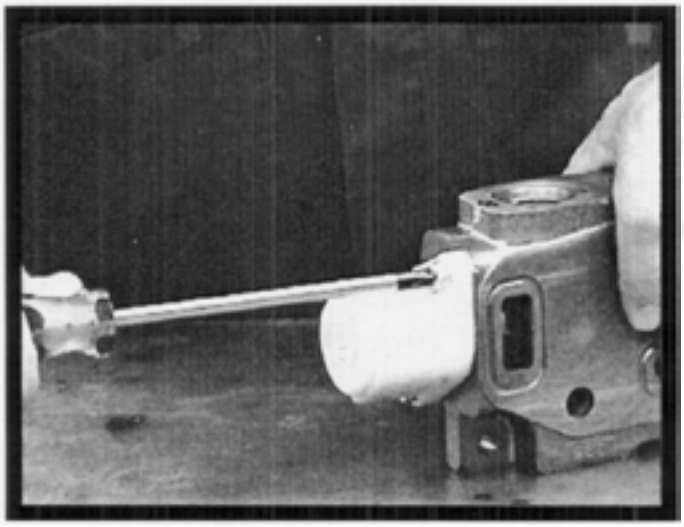
Apply a light coating of clean, hydraulic oil to the valve spool. Carefully insert the spool assembly into the housing. Use caution to avoid causing burrs. Be careful not to pinch, roll or damage the seals. Make sure that the spool and housing are in the proper orientation (see Step 1, page 6 disassembly).



Step 2 - Spool Seal and Back up

Apply Parker Super-O-Lube™ to the spool seal (Fig. 1, item 8) and slide it onto the spool. Slide on the back-up ring (Fig. 1, item 7). Push both items into the counter-bore until they bottom out.

Assemble the two, front, retainer plates (Fig. 1, item 6) using the two short, fillister screws (Fig. 1, item 9). Check retainer plates for proper alignment. Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.



Step 3 - Back cap

Install the back cap using the two, long, fillister screws (Fig. 1, item 4). Tighten to a final torque of 34 in. lbs. +/- 2 in. lbs.

Caution: Excessive torque will damage the back cap ears!

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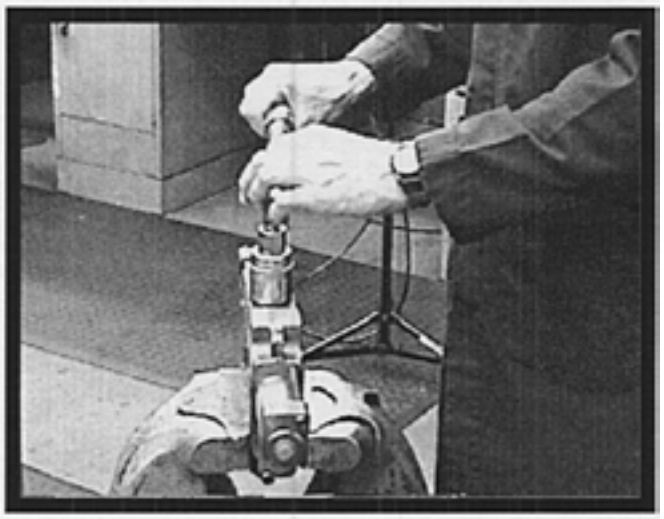
Valve Assembly Instructions

Step 4 - Install Transition Check

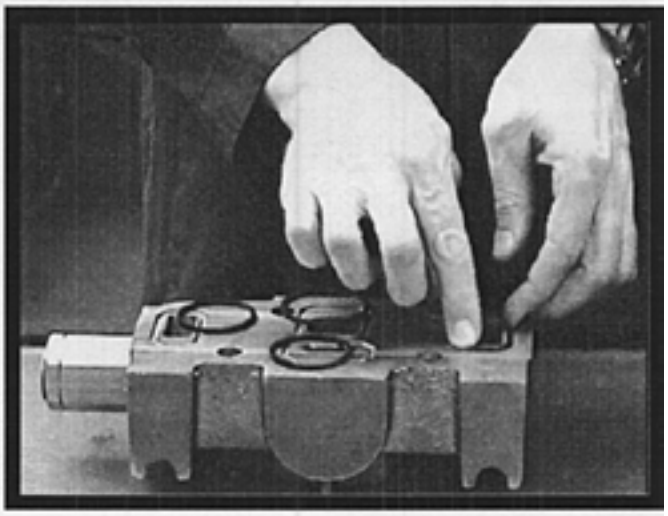
Inspect transition check components for cleanliness. Install check poppet (Fig. 1, item 13) into the transition check cavity. Align the check spring (Fig. 1, item 12) square to the poppet, then carefully place the check cap (Fig. 1, item 11) over the poppet and spring. Turning by hand, engage several threads. Tighten to a final torque of 75 ft. lbs. +/-4ft. lbs.



Step 5 - Relief Valves

Return all relief valves to their proper positions and torque to 75 ft. lbs

Install new, section seals. Place section seals (Fig. 1, items 1 & 2, or items 1 & 3) in the proper grooves. Make certain seals stay in their grooves during assembly.

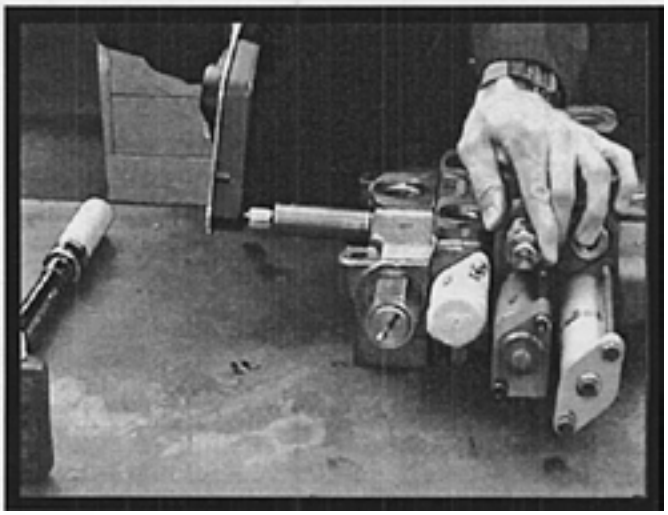


Step 6 - Install Tie Bolts

Slide the tie bolts through the inlet casting. If cap screws are used, place a washer on the cap screw prior to installation. Place the valve sections on the tie bolts in their proper sequence (see Step 1, page 4). Turning by hand, engage several threads in the outlet. If it is a VG series assembly, assemble nut and washer to either end of the stud and follow above instructions. Torque the tie bolts in a cross-corner pattern.

Tie Bolt Torque Values

VA20 - 29 ft. lbs. (348 in. lbs.)
VG20 - 42 ft. lbs. (504 in. lbs.)
VA35 - 34 ft. lbs. (408 in. lbs.)
VG35 - 75 ft. lbs. (900 in. lbs.)
VG80 - 150 ft. lbs. (1800 in. lbs.)



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Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks between sections	Pinched, blown or missing section seal	Replace section seal
	Stud fasteners not correctly torqued	Replace section seals and re-torque
	Mounting plate not level	Loosen mounting bolts and shim as required
	Contamination/burrs on seal	Clean seal groove, replace section seal
Oil leaks at either end of spool	Over-pressurized tank core	Correct high, back-pressure condition
	Worn or damaged spool seals	Replace seals and seal retainers
Spring - centered spools do not return to neutral	Broken centering spring	Replace centering spring
	Misalignment of operating linkage	Check linkage for mechanical binding
	Foreign particles in system	Clean valve and system
Load will not hold	Cylinder leaking or worn	Check cylinder - repair
	Port relief valve not holding	Remove and clean or replace
	Spool or housing scored or worn excessively	Replace section
Load drops when spool moved from neutral	Dirt or foreign particles lodged between check-valve poppet and seat	Disassemble, clean & reassemble
	Scored or sticking check-valve poppet	Replace poppet
No motion, slow, or erratic system operation	Worn pump	Check flow & pressure
	Defective cylinder or motor	Repair or replace
	Low-reservoir oil level	Add oil to specifications
	Clogged suction strainer	Clean or replace
	Suction line restricted	Check lines
	Relief valve not properly set	Check pressure setting
	Relief valve poppet or seat scored & sticking open	Replace relief valve
	Valve spool not shifted to full stroke	Check spool linkage travel

Pilot-to-open, spring biased closed, unbalanced poppet logic element

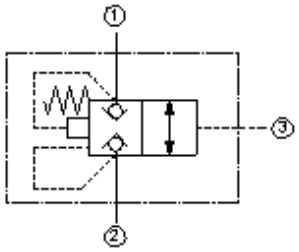
Capacity:
60 gpm (240 L/min.)

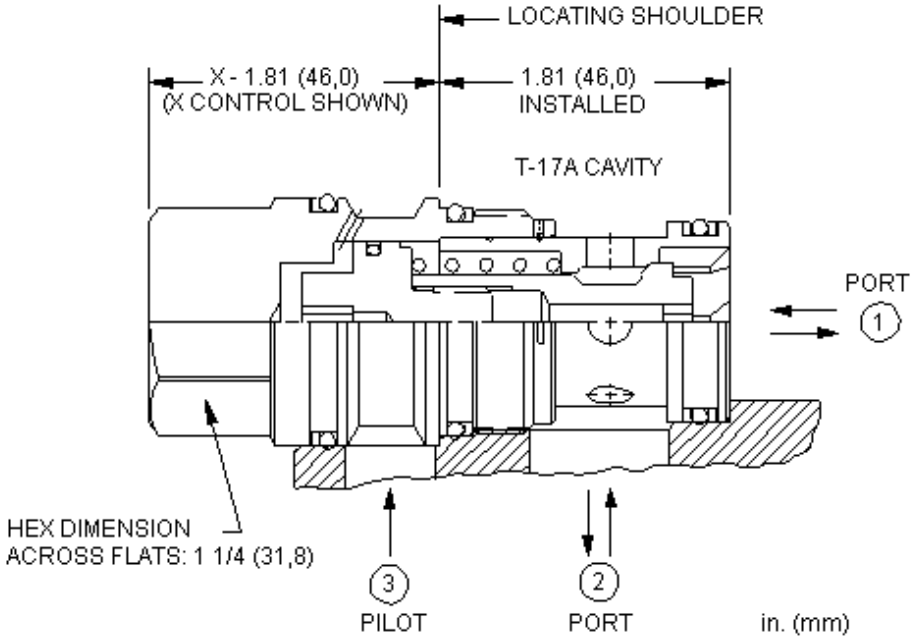
Functional Group:
Products : Cartridges : Corrosion Resistant : Logic Element : Unbalanced Poppet, Pilot-to-open, Switching Element, Spring biased closed, External Pilot Port 3 pilot source

Model:
LKHC

Product Description

These unbalanced poppet, logic valves are 2-way switching elements that are spring-biased closed. Pressure at either work port 1 or 2 will further bias the valve to the closed position while pressure at port 3 will tend to open it. The force generated at port 3 must be greater than the sum of the forces acting at port 1 and port 2 plus the spring force for the valve to open. NOTE: The pilot area (port 3) is 1.8 times the area at port 1 and 2.25 times the area at port 2.





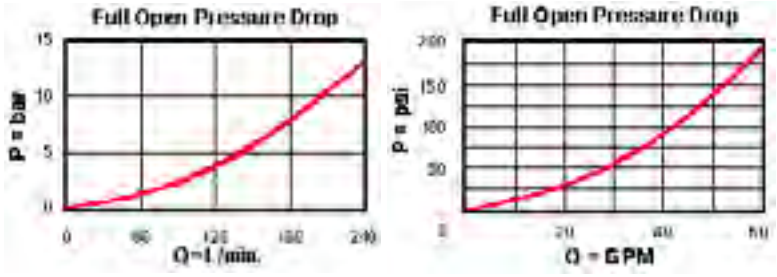
Technical Features

- Because these valves are unbalanced, operation is pressure dependent. Opening and closing of the poppet are functions of the force balances on three areas: 1) Port 1 = 100%, Port 2 = 80%, and Port 3 = 180%.
- These valves are pressure responsive at all three ports, therefore it is essential to consider all aspects of system operation through a complete cycle. Pressure changes at any one port may cause a valve to switch from a closed to an open position, or vice versa. All possible pressure changes in the complete circuit must be considered to assure a safe, functional system design.

- These valves have positive seals between port 3 and port 2.
- Incorporates the Sun floating style construction to eliminate the effects of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.
- Stainless steel cartridge options P or W are intended for use within corrosive environments with all external components manufactured in stainless steel or titanium. Internal working components remain the same as the standard valves.

Technical Data

	U.S. Units	Metric Units
Cavity	T-17A	
Capacity	60	240 L/min.
Area Ratio, A3 to A1	1.8:1	
Area Ratio, A3 to A2	2.25:1	
Maximum Operating Pressure	5000	350 bar
Maximum Valve Leakage at 110 SUS (24 cSt)	10	10 drops/min.@70 bar
Pilot Volume Displacement	.15	2,5 cc
Series (from Cavity)	3	
U.S. Patent #	4,795,129	
Valve Hex Size	1 1/4	31,8 mm
Valve Installation Torque	150 - 160	200 - 215 Nm
Seal Kits	Buna: 990-017-007	
Seal Kits	Viton: 990-017-006	



Option Selection

LKHC-X D N

Preferred Options

Control	*Cracking Pressure*	*External Material/Seal Material*

Standard Options

X Not Adjustable		**N** Buna-N
		V Viton

Pilot operated, balanced piston relief valve

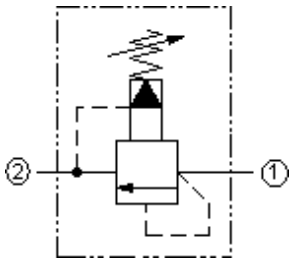
Capacity:
50 gpm (200 L/min.)

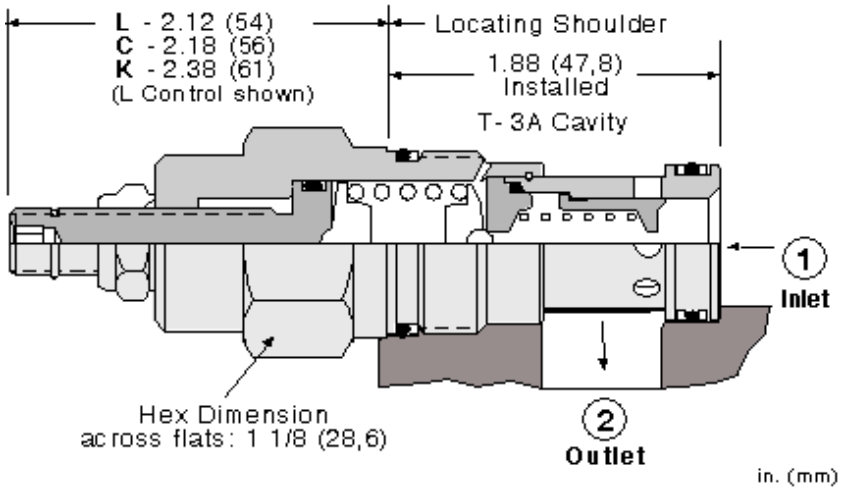
Functional Group:
: Cartridges : Relief : 2 Port : Pilot Operated, Balanced Piston

Model:
RPGC

Product Description

Pilot-operated, balanced-piston relief cartridges are normally closed pressure regulating valves. When the pressure at the inlet (port 1) reaches the valve setting, the valve starts to open to tank (port 2), throttling flow to regulate the pressure. These valves are accurate, have low pressure rise vs. flow, they are smooth and quiet, and are moderately fast.



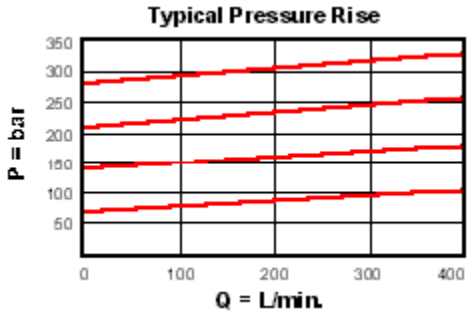


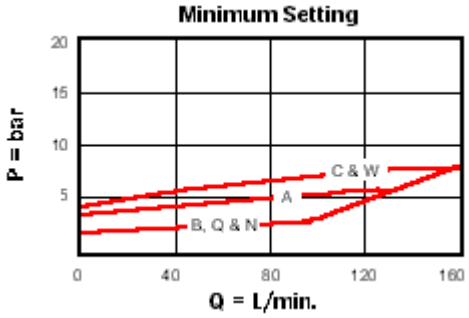
Technical Features

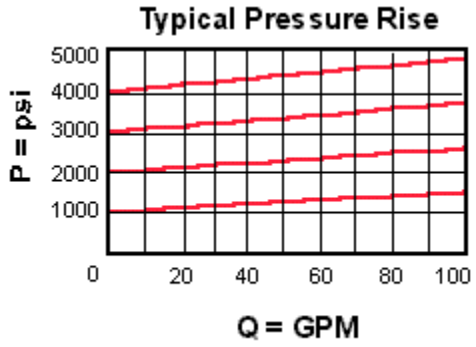
- Will accept maximum pressure at port 2; suitable for use in cross port relief circuits. If used in cross port relief circuits, consider spool leakage.
- Not suitable for use in load holding applications due to spool leakage.
- All 2-port relief cartridges (except pilot reliefs) are physically and functionally interchangeable (same flow path, same cavity for a given frame size).
- Incorporates the Sun floating style construction to minimize the possibility of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.
- Main stage orifice is protected by a 150 micron stainless steel screen.
- Back pressure on the tank port (port 2) is directly additive to the valve setting at a 1:1 ratio.
- Stainless steel cartridge options P or W are intended for use within corrosive environments with all external components manufactured in stainless steel or titanium. Internal working components remain the same as the standard valves.

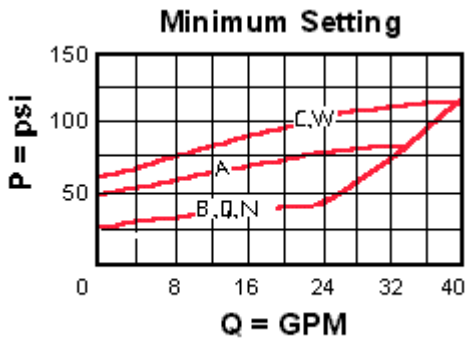
Technical Data

	U.S. Units	Metric Units
Cavity	T-3A	
Capacity	50 gpm	200 L/min.
Adjustment - Number of Clockwise Turns to Increase Setting	5	5
Factory Pressure Settings Established at	4 gpm	15 L/min.
Maximum Operating Pressure	5000 psi	350 bar
Maximum Valve Leakage at 110 SUS (24 cSt)	3 in³/min.@1000 psi	50 cc/min.@70 bar
Response Time - Typical	10 ms	10 ms
Series (from Cavity)	2	
Valve Hex Size	1 1/8 in.	28,6 mm
Valve Installation Torque	45 - 50 lbf ft	60 - 70 Nm
Adjustment Screw Hex Socket Size	5/32 in.	4 mm
Adjustment Nut Hex Size	9/16 in.	15 mm
Adjustment Nut Torque	108 lbf in.	12 Nm
Model Weight	.50 lb	0,25 kg
Seal Kits	Viton: 990-203-006	
Seal Kits	Buna: 990-203-007	









Option Selection

RPGC-L A N

Preferred Options

Control	*Adjustment Range*	*External Material/Seal Material*
L Standard Screw Adjustment	**A** 100 - 3000 psi (7 - 210 bar), 1000 psi (70 bar) Standard Setting	**N** Buna-N
	W 150 - 4500 psi (10,5 - 315 bar), 1000 psi (70 bar) Standard Setting	

Standard Options

J Capped Screw Adjustment	**C** 150 - 6000 psi (10,5 - 420 bar), 1000 psi (70 bar) Standard Setting	**P** Stainless/Buna-N
K Handknob	**E** 25 - 400 psi (1,7 - 28 bar), 200 psi (14 bar) Standard Setting	**W** Stainless/Viton
O Handknob with Panel Mount	**D** 25 - 800 psi (1,7 - 55 bar), 400 psi (30 bar) Standard Setting	**V** Viton
F Hex Head Screw with Locknut	**B** 50 - 1500 psi (3,5 - 105 bar), 1000 psi (70 bar) Standard Setting	
W* Max. Setting Limiter	**Q** 60 - 400 psi (4 - 25 bar), 200 psi (14 bar) Standard Setting	
3* Non Adjustable, Fixed Setting	**N** 60 - 800 psi (4 - 55 bar), 400 psi (30 bar) Standard Setting	
C* Tamper Resistant - Factory Set		

***Special Setting required, specify at time of order

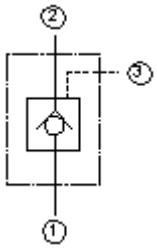
Pilot-to-open check valve with standard pilot

Capacity:
30 gpm (120 L/min.)

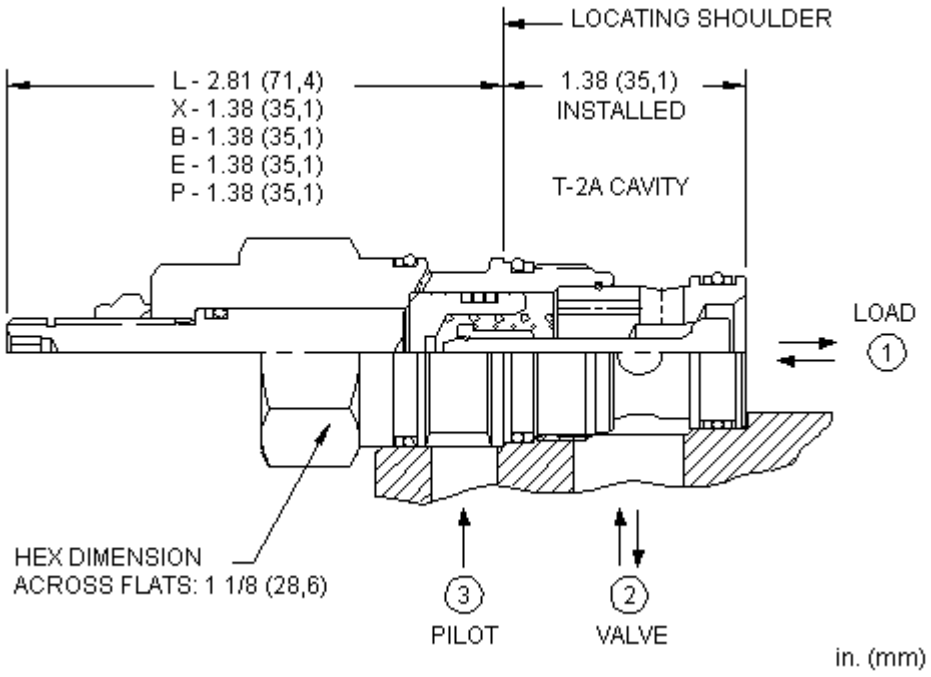
Functional Group:
Products : Cartridges : Pilot-to-Open Check Valve : 3-Port, Non-Vented : Standard Pilot, Steel Seat

Model:
CKEB

Product Description



This valve is a pilot to open check valve. It has a non-sealed pilot, a steel seat, and is non-vented. It allows free flow from the valve (port 2) to the load (port 1) and blocks flow in the opposite direction. Pressure at the pilot (port 3) will open the valve from port 1 to port 2. Pilot pressure needed at port 3 to open the valve is directly proportional to the load pressure at port 1. Pressure at port 2 directly opposes pilot pressure.



Technical Features

- Provides hose break protection, prevents loads from drifting and positively locks pressurized loads.
- Extremely low leakage. The seat and poppet are heat treated for long life. If the load drifts due to the valve, the seat has probably been damaged by contamination and the valve should be replaced.
- Pilot-to-open check cartridges are locking valves, not motion control valves. For motion control applications,
- Standard unsealed pilot allows air trapped in the pilot line to be purged from the circuit.
- Optional external porting out of the hex end of the cartridge is available for external piloting. In this configuration, port 3 is blocked. See Control options E, and P.
- This 3 port pilot-to-open check valve and 3 port counterbalance valves are physically interchangeable (i.e. same

use counterbalance valves.

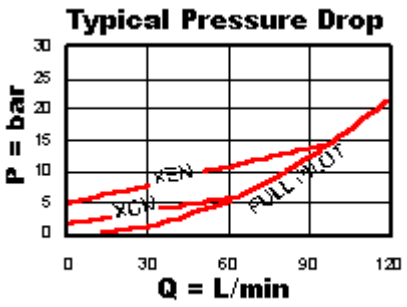
- Stainless steel cartridge options P or W are intended for use within corrosive environments with all external components manufactured in stainless steel or titanium. Internal working components remain the same as the standard valves.

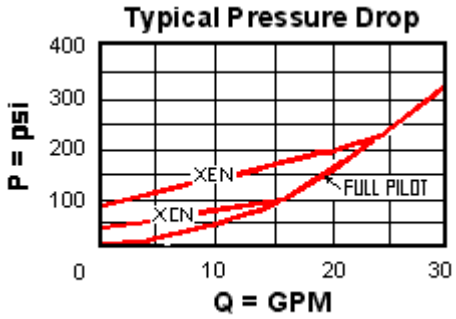
cavities, same flow path for a given frame size). However, cartridge extension dimensions from the mounting surface may vary.

- Incorporates the Sun floating style construction to eliminate the effects of internal parts binding due to excessive installation torque and/or cavity/cartridge machining variations.

Technical Data

	U.S. Units	Metric Units
Cavity	T-2A	
Capacity	30 gpm	120 L/min.
Pilot Ratio	3:1	3:1
Maximum Operating Pressure	5000 psi	350 bar
Maximum Valve Leakage at 110 SUS (24 cSt)	1 drops/min.	0,07 cc/min.
Series (from Cavity)	2	
Valve Hex Size	1 1/8 in.	28,6 mm
Valve Installation Torque	45 - 50 lbf ft	60 - 70 Nm
Model Weight	.50 lb	0,25 kg
Seal Kits	Buna: 990-202-007	
Seal Kits	Viton: 990-202-006	





MCCOY MOVING GLOBAL ENERGY FORWARD | DRILLING & COMPLETIONS

Option Selection

CKEB-X C N

Preferred Options

Control	*Cracking Pressure*	*External Material/Seal Material*
X Standard Pilot	**C** 30 psi (2 bar)	**N** Buna-N

Standard Options

L Manual Load Release	**A** 4 psi (0,3 bar)	**P** Stainless/Buna-N
	B 15 psi (1 bar)	**V** Viton
	D 50 psi (3,5 bar)	**W** Stainless/Viton
	E 75 psi (5 bar)	
	F 100 psi (7 bar)	

Customer specified setting stamped on hex +$1.10